MODELING THE IMPACT OF LANDSCAPE RESOURCES ON LOCAL POLICY DECISION, LOCAL DEVELOPMENT AND LOCAL ECONOMY

Dissertation

zur

Erlangung der naturwissenschaftlichen Doktorwürde

(Dr. sc. nat.)

vorgelegt der

Mathematisch-naturwissenschaftlichen Fakultät

der

Universität Zürich

von

Thomas Schulz

aus

Deutschland

Promotionskomitee:

Prof. Dr. Bernhard Schmid (Vorsitz, Leitung der Dissertation)

Prof. Dr. Hans Elsasser

Prof. Dr. Randall Walsh

Zürich 2010

Contents

Chapter 1	General Introduction	2
Chapter 2	Demand for Landscape Management: Regulation versus Financing	29
Chapter 3	The Role of Landscape Amenities in Regional Development: Evidence from Swiss Municipality Data	54
Chapter 4	How Local Landscape Resources affect Property Prices: Evidence from a Hedonic Pricing Model	83
Chapter 5	General Discussion	118
Chapter 6	Summary / Zusammenfassung	128
Acknowledgements		136
Curriculum Vitae		138

Chapter 1

General Introduction

To study how nature affects human beings and how human actions affect nature are fundamental concerns in today's society. Better knowledge of these relationships is the basis for decisions on future development. We therefore emphasize nature-human-interaction on the local level without a link to the classical global climatic change discussion.

Currently, there is a scarcity of broad studies in Europe which connect the complex relationship between landscape and policy, development, and economy at a local level (e.g., Tyrväinen et al. 2007, Kienast et al. 2007). This thesis therefore looks into the question of how publicly provided landscape resources and historical heritage affect local policy decision, local development and local economy. We focus on the impact of natural resources on local population, employment, and property while placing special emphasis on political decisions.

In contrast to earlier studies, this thesis combines these partial relations into one package and uses a nation-wide approach. The consideration of each relationship is important for the modeling of the complex impact of landscape resources at a local level. Before highlighting our thematic details, I offer the following subchapters to provide information on the background and technological aspects of this thesis.

Background

We can look back on approximately 40 years of research on the complex relationship between environmental economics and landscape change. At the end of the 1960’s and beginning of the 1970’s, economists like Crocker (1966), Krutilla (1967), Dales (1968), Kneese (1968, 1970), Rosen (1974), Freeman (1974) and Sugden et al. (1974) started to model the relationship between environment and economics with focus on pollution problems in the context of cost-benefit-approaches. These researchers were pioneers of environmental economics. Since the middle of the 1970’s they incorporated aspects of environmental policy in the environmental economics approaches (Arrow and Fisher 1974, Baumol and Oates 1975, Cropper 1976). Later, in the late 1970's and early 1980's, Haggett (1983) delved into this topic using a geographical perspective. His main questions were how much humans harm and damage the environment, and whether environmental changes are deleterious, tolerable and bearable. Haggett (1983) focused mainly on environmental aspects of flora, fauna and the abiotic linkage. He described the "random sub-effects" of the environment and concluded that nescience and absence of long-term experiences are the reasons for false actions and development.

A few years later, Smith (1990) revisited the topic and again delved into the question about whether and how the economic value of environmental amenities can be measured (e.g., environmental amenities such as open space or a nice view on a lake), which was already examined and discussed in the context of cost-benefit-analysis by former researchers in the 1970's. Smith was strongly influenced by the explanations of Freeman (1974) as well as Sugden et al. (1974) and enhanced their approaches. Based on the methods, Smith's question had to be cut in separate parts: What is the meaning of economic value? How can we define economic value? What are environmental amenities? How are they characterized? He turns away from the traditional framework of the resource-consumer relationship. Smith suggests that decision processes have to be included in the analysis. This thesis is oriented to the focus of Smith's framework and his relevant questions, because traditional economic theories help to identify consequences of different actions but they cannot represent decision-making processes and the link to allocation decisions involving natural resources and environmental amenities (Lucas 1986).

Furthermore, Kienast et al. (2007) published important aspects in the field of environmental economy and landscape change which are taken into special consideration in this thesis. Kienast et al. (2007) point out that biophysical, socio-economic and technological transformations lead to changes of land use, landscape properties and functions. The increasing mobility of persons and goods plays an important role in the dynamics of these changes. Today, landscape research is interdisciplinary, multi-spatial and time scaled. Due to the increasing availability of new technologies in the fields of computer science, remote sensing and communication, large amounts of data can be analyzed in a better and more varied way, thereby contributing to the rising importance of this field of science.

The conjunction of different disciplines opens different perspectives and targets. In spite of increasing significance of the results in this thesis, they will be interpreted differently and lead to different decisions. The reasons for this issue are to be found in the different values systems and basic conditions, which are considered in more details in the following subchapters.

Value systems

Value systems have significant relevance for interdisciplinary landscape-related research. They are the major drivers of landscape dynamics, perception and changes. Some of the main questions are: What is worth protecting? Which goods and services should be provided? Who cares about landscape? How and why do value systems vary? To answer these questions, it is important to consider human-landscape interaction.

There are conflicts between landscape development and management which arise from different value systems. Stakeholders have a different understanding of value systems than others. Furthermore, each individual has their own perception and valuation of human wellbeing regarding regional commitment and attachment. The theoretical fundament for the role of values is based on the ideas of Weber, Pareto, Durkheim and Simmel. All described the key function of values for human interactions as a reaction to utilization-orientated economic theories (Buchecker et al. 2007).

It is difficult to understand value effects, due to the different definitions in different scientific disciplines (Manfredo et al. 2004). For example, classical economic theory uses value systems which are considered as characteristics inherent in goods and determined in costs. In contrast, Friedrichs (1968), Brawn (1984) and Buchecker et al. (2007) depart from this classic economic theory. Friedrichs (1968) understood value systems as subjective judgement by economic agents of goods. Brown (1984) distinguished values assigned by process of evaluation (values as ideals of life). And Buchecker et al. (2007) summarized the values of landscape development as the overlap of the life world (social meaning) and the system world (land use).

Value systems, value perception and knowledge about value systems influence the human handling of nature, environmental change and protection (Haggett 1983). Heterogeneous preferences and the geographic extent of the market play an important role for measuring the environmental value of natural resources.

Basic conditions

Theories from environmental economics provide a variety of policy recommendations. In the past, traditional environmental economics has focused on pollution and climatic change issues. In contrast, we consider landscape resources, political borders and socio-economic effects, especially how the transformation of natural and cultural landscape has a multitude of consequences for human living space. This thesis takes up the changes caused by humans and leaves natural disasters for a different study.

The following example shows one of the crucial problems of the transformation of natural and cultural land during the 20th century. At the same time that rural regions in Europe lost inhabitants, urban and suburban regions increased several fold. Some of the negative consequences have been centralism and concentration of resource consumption (Kahn 2006). On the other hand, abandoned regions have had a great chance to develop and protect landscape amenities and historical heritage. One of the positive results lies for instance in recreational facilities and tourism benefits. There is also a possible benefits for the local population itself and local companies that prefer remoteness and deceleration.

In Switzerland for example, planners discovered the trend of so-called peri-urbanization in some regions, or the movement toward the edges of cities. This contrary trend shows that people decided to live in a rural region (e.g., AGR 2002). Over the years, this trend leads to the development of local rural centers with all the positive and negative consequences such as the development of the infrastructure and increasing tourism (e.g., in Visp-Brig in the canton Valais). The attractiveness of these rural regions is formed largely by the accessibility and availability of natural resources. A reason for the growth of these regions can be the change in technological and socio-economic conditions (Haggett 1983, Krysmanski 1971).

Besides the different focuses of Haggett, Smith and Kienast (see above), the characteristics of former and present problems have changed since the 1970s. Initially environmental policy was project oriented. It focussed on human well-being. Later it transformed to benefit-cost analysis (e.g., Graham 1981). The change from past to current approaches can be seen in the following factors: definition of public and quasi-public goods, physical linkage between resource features and observation by consumers, scale of policy (e.g., federal, canton and community level), time frame of decision (e.g., legislation period or a decade), technological investigations, sophisticated services, conceptual and ethical issues (Smith 1996). Hence, there is the problem of the adequate choice of method, which is dependent on different influences such as the treatment of system specific externalities, time dependence for calculating the present value, opportunity costs of unused resources (e.g. wild life resorts located far away from the observed community), different cost allocation and distribution of monetary gains and losses (Smith 1996).

The use of new technologies is closely connected to the adequate choice of methods. This thesis uses GIS (Geo-Information-System) technology which is addressed in more detail in following subchapter.

GIS technology

The modeling of the different data sets in this thesis is based on the widespread know-how in the area of GIS technology, in the context of environmental and economic data sources. Both data generation and data analysis are based on powerful GIS tools. Especially the link between landscape change and local economic development can be shown in an excellent and comprehensive way with GIS. Furthermore, a database management system (DBMS) integrated into the GIS technology allows an analytical working method with a broad and complex data structure (Bähr and Vögtle 1999, Bartelme 2000, Parker and Asencio 2008).

The beginning of the spatial oriented GIS application is based on research in the fields of physical geography and landscape ecology. Later, investigations into the field of environmental economics opened GIS for economic research questions. GIS in landscape ecology and classical landscape research consider landscape patterns to be shaped by complex dynamic processes acting through various spatial and temporal scales (Bolliger and Mladenoff 2005, Bolliger et al. 2007). Landscape dynamics are strongly connected to landscape structure. Both overlapping (e.g., forest vs. open space) and parallel (e.g., lake vs. forest) landscape elements influence the choice of method, for example by landscape monitoring (Forman and Godron 1986, Forman 1995, Lausch and Herzog 2002). Bolliger et al. (2007) explain these problems with the static vs. dynamic and discrete vs. continuous landscape indicators. These indicators can describe the landscape objects with a high level of aggregation.

In this thesis, landscape is observed as a static and discrete object, not as a dynamic process or a circle of development. In addition, the current environment is examined as a valuable object and is valued using economic methods. Therefore, GIS helps to evaluate non-market goods with a strong spatial connection. Most of these goods are freely available. The combination of GIS and economic methods provides the estimation of geo-referenced environmental economic values linked with landscape data.

After many years in which landscape analysis and economy have run parallel without any linkage, the field of disaster and risk-analysis has integrated GIS methods to find answers to economic questions (e.g., Bocksteal 1996, Geoghegan 1997, Anselin 2006). GIS has modified the familiar analysis methods especially in fields with strong spatial connection as in the dispersion of contamination, and optimization of transportation and networking. In contrast to the classical environmental economic research, this thesis offers stronger links between the landscape and the economy. Hence, GIS is the binding element regarding data, analysis and evaluation in the complex structure.

The potential of GIS technology for this thesis lies in GIS data and GIS modeling. The availability of data about landscape, politics, demographics, socio-economics and finances at different aggregated levels (e.g., single observations, community, canton or federal level) is the central challenge of the modeling. Thematically, spatial, temporal and scale-based conjunctions can be created with GIS tools. Moreover, analysis-specific variables can be generated from primary data (e.g., lake view is generated by GIS-modeling from data such as lake surface, digital elevation model, settlement area, forest area, buildings).

Scale effects

GIS modeling is strongly affected by scale effects because these can influence the choice of methods and resultant analysis. The time component is an important factor beside the method dependency. Hence, scale effects are of great importance when regarding the observational objects in the environmental economic context.

Based on the type of assumption, there are three directions of scale effects. Firstly, it is the scale effect itself. It means the accessibility and availability of resources, goods and markets. The location itself, the perimeter, the endowment, the neighborhood, the distance to competitors, the specific advantages, externalities and internal effects are important components. Therefore homogeneity versus heterogeneity location networks play an important role when considering scale effects (Tietenberg 2006).

Secondly, scale effects concern the valuation itself. Marginal prices for tradable goods depend on the size of the economy and the stage of development, especially regarding tax and regulatory programs. They often focus on resources which are connected to exchange of services to outside markets. Furthermore, there are restrictions for estimating individual value for non-marketed commodities – linking non-market resources to marketed goods and benefit measures. Finally, environmental resources also influence marginal rates of substitution for some marketed commodities (Tietenberg 2006).

Thirdly, there is the time component depending on the scale. Both short-term or long-term observations and effects depend on observational objects and policy options as well as present, future and past values. Two lines of practice of resource evaluation can be followed: Kneese and Schulze (1985) consider the ethical criteria, which accepts the future and current generation interests. The second line follows Page (1988), as he advocates an axiomatic approach to decision-making that means evaluating gains and losses over long time periods.

Thematic overview

After so far having given general background information as well as detailed explanations on GIS technology we will now focus on the main points of this thesis. We consider the complex relationship between local policy decision, local development and local economy in Switzerland based on detailed geographical, socio-economic and fiscal data. The linkage between these parts is illustrated in Figure 1. The following example should give a clear picture of the complex connection between these three approaches: for instance, there is a political decision for a new landscape reserve – this decision may have an influence on the local economy because there is a likelihood of limits and restrictions on development of industrial areas – and these limits could have an impact on employment development as well as population development.

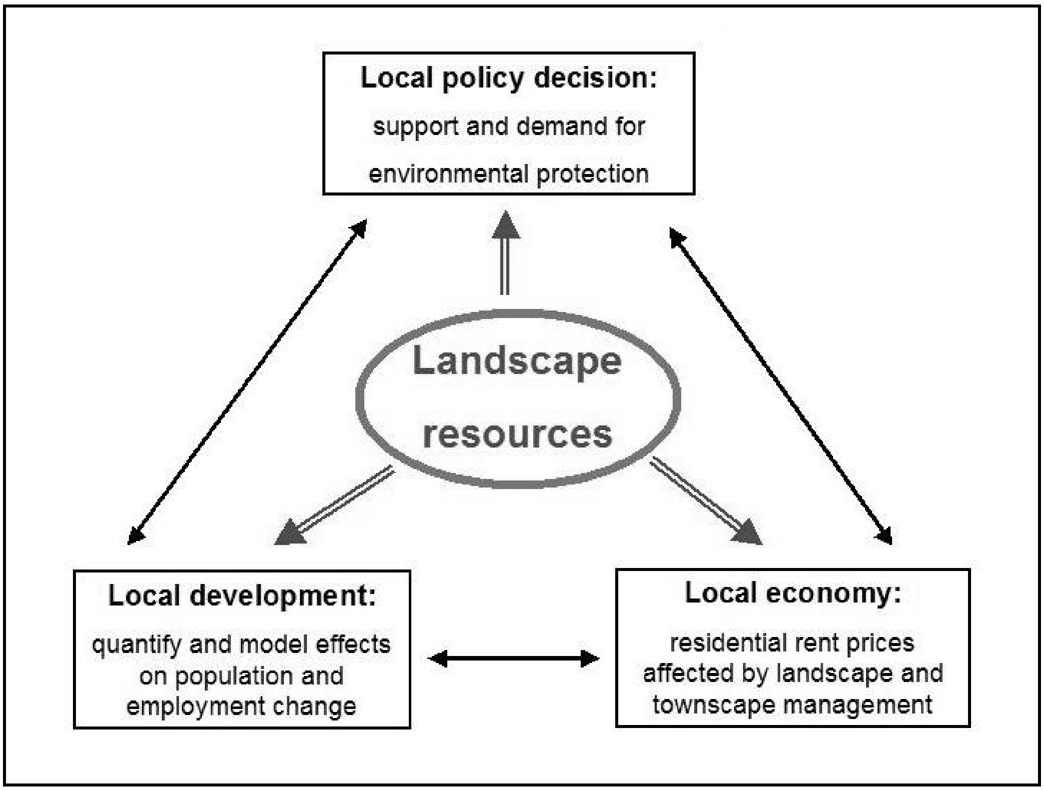


Figure 1. Relationship between local policy decision, local development and local economy

The three approaches in this thesis are linked through their common dependency on landscape resources. For instance, landscape resources can have a direct impact on policy, development and economy according to location parameter and endowment. But the indirect network connection and interaction is much more apparent in society than the direct way. Specifically landscape parameters and landscape changes exert pressure on political decisions, as well as socio-economic location factors, which mutually depend on political action.

The following subchapters offer more details of each approach in this thesis regarding the impact on landscape resources. The first subchapter covers political decisions and environmental policy in an in-depth way by analyzing government interventions and referendums in Switzerland. Decision making processes, regulation policy, demand and preferences for environmental policy are considered. The second subchapter addresses the issue “Population and employment in the context of local development and environment”. Aspects of population growth and limits of development are also considered. Finally, in the third subchapter we are concerned with “Modeling of landscape and local economy”. Therefore, we introduce three possible approaches to model the relationship between landscape resources and local economic changes.

Political decisions and environmental policy

In his research, Kahn (2006) provides one of the pivotal questions in environmental policy: Why are government interventions necessary? One reason could be that locations become more sensitive regarding demand for and supply of environmental protection and therewith connected regulation. Another reason for example is the regulation of organic food production; it sets standards and protects the consumers. Both together depend on interests for and access to political information.

In Chapter 2 we follow the regulation approach and contrast that with an alternative financing approach. We delve into the question about the support for landscape regulation policy and ask if there are other political ways for landscape protection. Moreover, different interest groups discuss the regulation approach with different focuses and targets. A case study published by Buchecker et al. (2007), for example, highlights the problem of how different interest groups deal with environmental policy decisions in which managers and policy makers of local landscape projects have a different view of expectation and target than the local population. The latter have greater personal preferences directly focused on existing natural objects (individual well-being), than on objective views about ecology, environmental economy and the complex connection in the background (collective well-being). Bäuerle (1984) has already provided the basis for the research of personal values and preferences in the context of how people judge their local environment. His research focused on laws and public regulations which have an impact on decision processes. Therefore, laws and regulations can be directly considered for decisions in the spatial planning.

Another important foundation for this thesis is Smith's (1996) examination that cost-benefit evaluation deals with regulation policy. These types of policy decisions change relative prices and incomes. General equilibrium response should be considered in the analysis, because here the full connection regarding environmental economics is examined. Regarding restrictions linking non-market resources to market goods policy intended to affect environmental resources also influences marginal rates of substitution for some marketed commodities, aside from sectoral effects associated with differential cost of environmental regulation (Smith 1996).

All these approaches and methodical improvements (e.g., Bäuerle 1984, Smith 1996, Buchecker et al. 2007) are strongly focused on the regulation approach, which is a common and popular environmental policy approach. But these studies do not comprehensively address political processes as well as people's intentions. For this reason, we investigate demand for landscape management based on diverse landscape resources. Thus, we also focus on alternative approaches for ecosystem services.

The uncertainty of the political process and policymakers regarding different preferences is an important aspect to be considered in our research. Indirect long-term effects of political decisions, for example, were not considered in analysis and research questions. The first initial approaches were published by Just et al. (1982) and McFadden (1984). They measured partial and general equilibrium demand and supply functions for the effected market and consider the spatial dependence of the decision-making processes. Later, Bocksteal and Strand (1987b), Smith (1990) and Kling (1992) assumed imperfect substitutes for an individual estimate. They hypothesized effects of uncertainty on policy analysis. All these investigations considered political decisions and the following effects on the environment for the first time.

In Chapter 2 we have to consider the question of the uncertainty of the political process. Therefore, in contrast to former studies, we understand the political process as a complex unit from the point of conception until implementation. Regarding the weakness of implementation by subsidy policy, we account for demand as well as support for both regulation and alternative financing approaches.

Thus, we consider that political decisions in general predict the future direction for the people's exposure with the environment. With a view to the federal level in Switzerland, there is a high potential for environment-related political decisions. Since 1980, there were four referendums on federal level in Switzerland (1987: mire conservation – Rothenthurm initiative[1], 1992: water protection law[2], 2002: saving our waters[3], 2008: law for the right of objection by associations[4]). The referendums in 1987 and 1992 were accepted whereas the referendums in 2002 and 2008 were turned down. Furthermore, there were three federal initiatives focusing on forest protection (1986: "Campaign against forest decline", 1987: "Save our forests", 2008: "Save the Swiss

---

[1] Swiss Confederation is obliged according to its constitution to conserve the „mires and mire landscapes of national importance and particular beauty".

[2] The purpose of the federal law was to protect waters against all harmful effects. The federal law shall apply to all surface and subterranean waters.

[3] Completions for the federal law on protection of waters.

[4] Modification of the federal law for from the right of objection by associations regarding environmental and spatial planing affairs.

forest”), which either failed at the collection stage or were cancelled (FOEN 2009). These important referendums and initiatives were focused on the federal level in Switzerland. But it is well known that political actions were often decided on the local level. We therefore adjust our observation scale to the local level in order to research the impact of environment-related policy. The canton of Zurich is an excellent case study for our investigation and a pioneer of environmental policy in Switzerland.

Population and employment in the context of local development and environment

Hanley et al. (2001) asked the question “Growth versus Development – what does it mean?” in the context of sustainable development. Increasing resources, which include capital, labor (influenced by migration and population change), land, energy and material resources are affected by externalities. They are the parameters which show the limits on growth and development. Increasing scarcity of environmental quality drives up its relative price and this means it is consumed less and preserved more. Environmental quality is connected to the stage of development. As Beckerman (1992) explained, „the only way to attain a decent environment [..] is to become rich“. The relationship between income level and environmental quality can be described as an inverted-U-shaped curve – the Environmental Kuznets Curve (EKC) – which empirically shows the limits of development (Grossman and Krueger 1995). The connection of employment rate and population change to environmental quality can also be shown with a EKC.

The above explanations reinforce the view that population and employment change can be key drivers for local environmental degradation or improvement (Kahn 2006). Especially these factors surrounding a settlement area are a challenge for the development of the future infrastructure. The outcome of possible growth are negative effects that are higher than the creation of economic value. These externalities constitute a tightrope walk between bundling resources and external consumption as well as dependency.

We follow this tightrope walk in our research and focus on the impact of traditional location factors in Chapter 3. Thus, we place a special emphasize on income, taxes, socio-demographic composition, economic structure and infrastructure aspects. In this context, there is the employment rate that depends on the age structure effect and female employment rate, which are important keys for the population development. Furthermore, the availability of savings is, in turn, affected in part by age structure of the population. Older populations are presumed to save more because less is spent directly on the care and nurturing of children (Kelley and Schmidt 1994).

Also, Tietenberg (2006) highlights effects of population growth on economic development. For example, population development with focus on education, knowledge and usage of resources contributes to a sustainable development. Population change affects economic change depending on the stage of development. Population and economic development are always connected to pressure on depletable and renewable resources. Tietenberg (2006) describes the population environment connection as negative effects of population density (especially connected with poverty). For instance, the expansion of agricultural and forestry land leads to competition between land for organic food production and recreational facilities. And scarcity of land can implicate migration and commuter streams (e.g., between living, working, recreation places). Tietenberg (2006) points out that population growth inevitably degrades the environment, depending on the perspective of induced innovation vs. downward spiral. He believes that the social and economic background of the growing part of the population influences the development.

We take account of Tietenberg's landscape amenity approach and expand his research to question how open space development and aesthetic landscape features affect local development. We thereby build a bridge between traditional location factors and landscape resources as parameters for local development with regards to population and employment change. We turn attention to the research question of how publicly provided landscape resources such as inventories of landscapes with national significance affect local development, because these resources seem to be uncoupled from traditional location factors.

Another important point in the context of our research is that Jacobs (1969) emphasized that diverse population development provides maximum benefits. Five years earlier, Vernon‘s (1966) research showed that local governments push and pressure heterogeneous groups of interests. But a negative effect on this diverse development is that the growth of low income and less educated population supports less environmentally related projects (Timmens 2002). Furthermore, public goods provision is lower in more diverse communities (Alesina et al. 1999). Populations with higher income tend to have higher education. And, there is a tendency of richer consumers for sustainable investigations (Becker and Mulligan 1997). That means the access and process information about how environmental hazards affect their wellbeing is much stronger. Furthermore, wealthy people tend to refrain from spontaneous spending. This behavior leads to both public and private benefits (Kahn 2006). And, this helps low income population with regards to environmental quality and greater technological progress, that means greater accessibility and availability for each individual (Pfaff et al. 2004).

The causality of maximum benefits, sustainable investigations and well-being is strongly reflected in a discussion for the support of subsidies. We therefore emphasize Swiss agricultural policy, looking at connected subsidies and the impact of local development.

Modeling of landscape and local economy

We follow in line with Smith (1996), who considers three possible approaches to model the relationship between landscape and local economic changes with focus on non-market goods. The solution for these problems with improvement of the environmental quality can be non-market valuation stretched beyond public investment and policy evaluation. Travel costs, hedonic and adverting behavior models can help to reconstruct transactions with indirect methods for non-market valuation (Smith 1996).

Travel costs models observe visitation rates for single trips with individual data. The costs involve the recreational facility to included related travel costs, access charges, equipment costs, supplies etc. These costs are directly related to activities. The hedonic property approach is connected to the housing price or rent. This approach uses market data and then breaks down the price into its components including house characteristics, neighborhood characteristics and environmental characteristics (Freeman 1993). Hedonic pricing models give an answer to the question: What do people perceive as quantity of the amenity services conveyed by site location? Finally, adverting behavior models address the action that reflects implicit trade-offs of costs for risk reduction or the improvement of environmental quality. Therefore, a quantity cost analysis depends on each individual activity, the bases of which are the hypothesized preference and household production function, as well as relevant budget and time constraints (Graham 1981).

All three approaches arrange a view to treating natural and environmental resources as assets. Former researchers (e.g., Haggett 1983, Freeman 1993) had a view only to renewable versus non-renewable resources and decisions which connected with static approaches to inter-temporal availability of resource services. Smith (1996) exposes two main reasons why natural and environmental resources should be modeled as assets, with appropriate recognition of the inter-temporal dimensions of allocation decisions: firstly, uncertainty that enters resources can be evaluated in two distinct ways – as an influence on the economic agents analysts and in the evaluations about policy. Secondly, the scale of the action being evaluated matters by expanding the magnitude of the influence of policy decisions at each point in time and through time. The outcome of this is a ongoing discussion between capitalization versus policy for past and future losses.

Already Krutilla (1967), McConnell (1983), Freeman (1985) and Smith (1987a, 1987b) have investigated methodological existence values in the context of use vs. non-use values as permanent assets. Use-values do not capture all total economic values because of incomplete choices. In contrast, non-use values or existence values are only relevant if they influence the human well-being and decision making. The quality of environmental resources also changes with technology and characteristics of these resources. Hanemann (1978) and Bocksteal et al. (1987a) examined approaches for measuring the quality of revealed-preference-based models. They rely on indirect methods like travel cost, hedonic property and household production models.

We have decided to use and to expose the hedonic pricing approach, because of the direct link between environmental goods and market prices. Therefore, we can use a wide pool of experiences from reputable researchers such as Sherwin Rosen, Myrick Freeman, Kerry Smith, who have established and developed the basics of the hedonic pricing approach. Furthermore, Elena Irwin, Luc Anselin, Jacqueline Geoghegan etc. for example enrich with their work the usage of GIS in connection with the hedonic pricing approach. With a view on non-market resources, the hedonic pricing method has a great analysis potential..

The importance of our study is that we emphasize a nation-wide approach with a broad set of explanatory variables. We thus focus our analysis in Chapter 4 especially on the question how landscape, townscape management and natural amenities influence property prices. We therefore suggest that the measurement of non-market resources imply more than investment costs. Economic agents are always linked with the market. Hence, it is necessary to include the impacts of outside markets. Environmental quality change affects people's wellbeing. This affects market-based demands and supplies, which are not always linked to the prices (Smith 1996).

The definition of the market is essential for the hedonic pricing approach. Especially: are there specifications and assumptions for the Swiss market? How do natural resources influence the market? Hanley et al. (2001) focused especially on the aspects of the environmental market. They define the market as follows: „Market serves society by efficiently organizing economic activity. Markets use prices to communicate the requirements and limits of a diffuse and diverse society so as to bring about coordinated economic decisions in the most efficient manner." Furthermore, they point out "Markets can fail. And when we are dealing with environmental resources that cut across nations and generations, the conditions under which markets work well do not necessarily hold up."

This described uncertainty of the market provides the aspect to measure the value of non-marketed natural resources as assets (Tietenberg 2006). The process of translating single values of each natural amenity to the value of the asset requires that the analyst defines the geographic extent of the market.

Outline of the thesis

The focus in this thesis is the relationship between rural landscape amenities and local policy, local development and local economics. The availability of geo-physical, socio-economic and fiscal data make Switzerland an excellent case study. Further advantages are the heterogeneous landscape, the centrality in Europe and the stable political system. In contrast to countries of the European Union the influence of neighboring countries regarding policy and economics is low.

Three approaches are the foundation of this study: First of all, we look into political issues as well as into questions of support and demand for environmental protection. Secondly, the regional growth model by Carlino and Mills (1987) is used to quantify and model effects of natural amenities on population and employment change. Thirdly, with the hedonic pricing method we analyze residential rent prices which are affected by landscape and townscape management as well as by natural amenities. All three approaches in combination can cover the complex system of landscape and local development in a better way than former studies. For example, population growth as well as property prices can be affected by natural amenities. The linking-up of these approaches makes a single observation impossible. All three approaches together can model the local impact and the local benefits of public goods, their protection and effects in a federal system. These approaches focus on European types of landscape and historical heritage development. The work of Roe et al. (2004) for example shows a complex approach of the relationship between natural amenities, housing values and residential growth in the United States. Roe et al. (2004) link different methods in a similar way to explain interactions with the environment. This thesis makes a contribution to investigating an empirical basis for public finance of environmental goods and regional policy decisions. Additionally, knowledge of environmental system structure is necessary to model this human impact.

To date, there is no Swiss study relating local development to the imposing natural amenities of rural landscapes and historical heritage. This thesis provides an examination of the relationship between natural amenities and several measures of local development in Switzerland based on detailed geographical, socio-economic and fiscal data.

This thesis offers a contribution to environmental economics and regional geography. With this research we can clearly show that landscape resources affect local development and that landscape management has an important impact on local economic development. We can present the first nation-wide approach in the research field of landscape resources and local development. Furthermore, we create a large nation-wide GIS-based dataset, which is unique to Switzerland.

In Chapter 2, we present the result of an analysis of voter support for a proposition to create landscape reserves in the densely populated canton of Zurich. Furthermore, we contrast the pattern of voter support for this “regulation” measure with the support among the same population for a "financing" measure that proposed to maintain landscape quality through increased public spending for the management of landscape amenities and historical heritage.

Chapter 3 applies the classic simultaneous equations model by Carlino and Mills (1987) to data from 2467 municipalities in Switzerland, in order to examine how landscape amenities and related policies as well as fiscal, demographic and infrastructure variables affected regional development. To estimate the results we focus on the population and the employment equation.

In Chapter 4, we use the hedonic pricing approach to study how local landscape resources affect property prices. Therefore, we analyze a cross section of 80814 apartments in 956 Swiss communities to estimate the value of the landscape as reflected by apartment prices. Along with the property attributes, our analysis includes GIS-based municipality-level variables that characterize location-specific amenities and other neighborhood features.

References

AGR 2002. Richtplan des Kantons Bern. Amt für Gemeinden und Raumordnung des Kantons Bern.

Alesina, A., Baqir, R., Easterly, Q., 1999. Public goods and ethic divisions. Quarterly Journal of Economics 114(4):1243-84.

Anselin, L., 2006. GeoDa: An introduction to spatial data analysis. Geographical Analysis 38(1):5-22.

Arrow, K.J., Fisher, A.C., 1974. Environmental preservation, uncertainty, and irreversibility. Quarterly Journal of Economics 88 (5):312-19.

Bähr, H.-P., Vögtle, T., 1999. GIS for environmental monitoring. E. Schweizerbart'sche Verlagsbuchhandlung (Nägele u. Obermiller), Stuttgart, Deutschland.

Bartelme, N., 2000. Geoinformatik: Modelle, Strukturen, Funktionen. 3. erw. und aktualisierte Auflage. Springer, Berlin, Deutschland.

Bäuerle, G., 1984. Der Freiraum als räumliches Wertobjekt: Ansatz zu einer räumlichen Werttheorie. Minerva-Publikation, München, Deutschland.

Baumol, W.J., Oates, W.E., 1975. The theory of environmental policy. Englewood Cliffs, Prentice Hall Incorporation, New Jersey, USA.

Becker, G., Mulligan, C., 1997. The endogenous determination of time preference. Quarterly Journal of Economics 112(3):729-58.

Beckerman, W., 1992. Economic development and the environment: Conflict of complementarity? Policy Research Working Paper Series 961. The World Bank.

Bocksteal, N.E., McConnell, K.E., Strand, I.E., 1987a. Benefits from improvements in Chesapeake Bay water quality. In: Benefits analysis using indirect or imputed market methods. Report to US Environmental Protection Agency.

Bocksteal, N.E., Strand, I.E., 1987b. Regression error and benefit estimates. Land Economics 63(2):11-20.

Bocksteal, N.E., 1996. Modeling economics and ecology: The importance of a spatial perspective. American Journal of Agricultural Economics 78(5):1168-1180.

Bolliger, J., Wagner H.H., Turner, M.G., 2007. Identifying and quantifying landscape patterns in space and time. In Kienast et al., 2007. A changing world: Challenges for landscape research. Springer, Dordrecht, The Netherlands.

Bolliger, J., Mladenoff, D. J., 2005. Quantifying spatial classification uncertainties of the historical Wisconsin landscape (USA). Ecography 28(2):141-156.

Brown, T.C., 1984. The concept of value in resource allocation. Land Economics 60(3):231-246.

Buchecker, M., Kianicka, S., Junker, B., 2007. Value systems: drivers of human-landscape interactions. In: Kienast et al., 2007. A changing world: Challenges for landscape research. Springer, Dordrecht, The Netherlands.

Carlino, G.A., Mills, E.S., 1987. The determinants of county growth. Journal of Regional Science 27(1):39-54.

Crocker, T., 1966. The structure of atmospheric pollution control systems. In: Wolozin, H., The economics of air pollution, W.W.Norton, New York, USA.

Cropper, M., 1976. Regulating activities with catastrophic environmental effects. Journal of Environmental Economics and Management 3(6):1-15.

Dales, J., 1968. Pollution, property and prices. University of Toronto Press, Toronto, Canada.

FOEN 2009. Federal Office for the Environment. Website 14-09-2009: http://www.bafu.admin.ch/dokumentation/gesetzgebung/01226/index.html?lang=de

Forman, R.T.T., 1995. Land mosaic: the ecology of landscpes and regions. Cambridge University Press, Cambridge, United Kingdom.

Forman, R.T.T., Godron, M., 1986. Landscape ecology. John Wiley & Sons, New York, USA.

Freeman III, A.M., 1974. On estimating air pollution control benefits from land value studies. Journal of Environmental Economics and Management 1(1):74-83.

Freeman III, A.M., 1985. Supply Uncertainty, Option Price, and Option Value. Land Economics 61(2):176-181.

Freeman III, A.M., 1993. The Measurement of Environmental and Resource Values. RFF Press, Washington, USA.

Friedrichs, J., 1968. Werte und soziales Handeln. Ein Beitrag zur soziologischen Theorie. In: Veröffentlichungen der Akademie für Wirtschaft und Politik, Hamburg, Deutschland.

Geoghegan, J., Wainger, L.A., Bocksteal, N.E., 1997. Spatial landscape indices in a hedonic framework: An ecological economics analysis using GIS. Ecological Economics 23(3):251-264.

Graham, D.A., 1981. Cost-benefits analysis under uncertainty. American Economic Review 71(9):715-25.

Grossman, G.M., Krueger, A.B., 1995. Economic growth and the environment. The Quarterly Journal of Economics, MIT Press 110(2):353-77.

Haggett, P., 1983. Geographie – Eine moderne Synthese. Harper & Row, New York, USA.

Hanemann, W.M., 1978. A methodological and empirical study of the recreation benefits from water quality improvement. PhD thesis. Harvard University.

Hanley, N., Shogren, J.F., White, B., 2001. Introduction to environmental economics. Oxford University Press, Oxford, United Kingdom.

Jacobs, J., 1969. The economy of cities. Vintage Press, New York, USA.

Just, R., Hueth, D.L., Schmitz, A., 1982. Applied welfare economics and public policy. Englewood Cliffs, Prentice Hall Incorporation, New Jersey, USA.

Kahn, M.E., 2006. Green Cities – Urban growth and the environment. Brookings Institution Press, Washington, USA.

Kelley, A.C., Schmidt, R.M., 1994. Population and income change: Recent evidence. World Bank discussion papers 249:109-116.

Kienast, F., Wildi, O., Ghosh, S., 2007. A changing world: Challenges for landscape research. Springer, Dordrecht, The Netherlands.

Kling, C.L., 1992. Some results on the variance of welfare estimates from recreation demand models. Land Economics 68(8):318-28.

Kneese, A.V., 1968. Economics and the quality of the environment: Some empirical experiences. In: Social sciences and the environment, edited by Garnsey, M., Gibbs, J., University of Boulder Press, Boulder, USA.

Kneese, A.V., Ayres, R.U., d'Arge, R.C., 1970. Economics and the environment: A materials balance approach. The Johns Hopkins University Press for Resources for the Future, Baltimore, USA.

Kneese, A.V., Schulze, W.D., 1985. Ethics and environmental economics. In: Handbook of Natural Resources and Energy Economics I. Kneese, A.V., Sweeney, J.L. (eds), Amsterdam, The Netherlands.

Krutilla, J.V., 1967. Conservation reconsidered. American Economic Review 47(9):777-86.

Krysmanski, R., 1971. Die Nützlichkeit der Landschaft. Beiträge zur Raumplanung Bd. 9, Düsseldorf-Gütersloh, Deutschland.

Lausch, A., Herzog, F., 2002. Applicability of landscape metrics for the monitoring of landscape change: Issues of scale, resolution and interpretability. Ecological Indicators 2(1-2):3-15.

Lucas, R.E. Jr., 1986. Adaptive behavior and economic theory. In: The behavioral foundations of economic theory. Special issues of Journal of Businness edited by Hogarth, R.M., Reder, M.W.:401-427.

Manfredo, M.J., Teel, T.L., Bright, A.D., 2004. Application of the concepts of values and attitudes in human dimensions of natural resources research. In: Manfredo M.J. et al. (eds.), Society and Natural Resources. A summary of knowledge, prepared for the 10th International Symposium on Society and Resource Management.

McConnell, K.E., 1983. Existence and bequest value. In: Managing air quality and scenic resources at national parks and wilderness areas, edited by Rowe, R.D., Chestnut, L.G.. Westview Press, Boulder, USA.

McFadden, D. (1984). Welfare analysis of incomplete adjustment to climatic change. In: Smith, V. K., and Witte, A. D. (Eds.) Advances in applied micro-economics 3. JAI Press, Greenwich, United Kingdom.

Page, T., 1988. Intergenerational equity and the social rate of discount. In: Smith, V.K. (ed.), Environmental resources and applied welfare economics: Essay in honor of Krutilla, J.V.. Resource for the Future, Washington, USA.

Parker, R.N., Asencio, E.K., 2008. GIS and spatial analysis for the social sciences: coding, mapping and modeling. Routledge, New York, USA.

Pfaff, A.S.P, Chaudhuri, S., Nye, H., 2004. Household production and environmental Kurznets curves: Examination the desirability and feasibility of substitution. Environmental and Resource Economics 27(2):187-200.

Roe, B., Irwin, E., Morrow-Jones, H.A., 2004. The effects of farmland, farmland preservation, and other neighborhood amenities on housing values and residential growth. Land Economics 80(1):55-75.

Rosen, S., 1974. Hedonic price and implicit markets: Product differentiation in perfect competition. Journal of Political Economy 82(2):34-55.

Smith, V.K., 1987a. Non use values in benefit-cost analysis. Southern Economic Journal 54(7):19-26.

Smith, VK., 1987b. Uncertainty, benefit-cost analysis, and the treatment of option value. Journal of Environmental Economics and Management 14(9):283-92.

Smith, V.K., 1990. Estimating recreation demand using the properties of the implied consumer surplus. Land Economics 66(5):111-20.

Smith, V.K., 1996. Estimating economic values for nature: Methods for non-market valuation. Edward Elgar, Cheltenham, United Kingdom.

Sugden, R., Williams, A., 1974. A practical guide to cost-benefit analysis. Oxford University Press, Oxford, United Kingdom.

Tietenberg, T., 2006. Environmental and natural resource economics. Addison-Wesley, New York, USA.

Tyrväinen, L., Mäkinen, K., Schipperijn, J., 2007. Tools for mapping social values of urban woodlands and other green areas. Landscape and Urban Planning 79(1):5-19.

Vernon, R., 1966. The myth and reality of our urban problem. Harvard University Press, Cambridge, USA.

Chapter 2

Demand for Landscape Management: Regulation versus Financing

Thomas Schulz[1] and Felix Schläpfer[2]

published in Society and Natural Resources, 22:1, 27-41, 2009

[1]Institute of Environmental Sciences, University of Zurich, Zurich, Switzerland

[2]Socioeconomic Institute, University of Zurich, and Institute for Environmental Decisions, Swiss Federal Institute of Technology, Zurich, Switzerland

Abstract

With continuing loss of open space around growing urban centers, measures to maintain periurban landscape quality are gaining importance on political agendas. Understanding the demand for alternative approaches to landscape management is crucial for designing efficient policies and acceptable financing arrangements. Here, we analyze voter support for a proposition to create landscape reserves in the densely populated canton of Zurich, Switzerland. We then contrast the pattern of voter support for this ''regulation'' measure with the support among the same population for a ''financing'' measure that proposed to maintain landscape quality through increased public spending for the management of landscape amenities and historical heritage. The demand for both landscape regulation and financing increased with decreasing local open space. The role of income differed between the two propositions and between more urban and more rural populations. Our descriptive results should contribute to the design of widely acceptable policies and financing arrangements.

Keywords: amenities, demand analysis, ecosystem services, income elasticity, landscape management, open space, public goods, referendum, voting

We are grateful to Jeff Kline and four anonymous reviewers for extremely valuable comments and to Fabian Waltert for preparing the income data.

Introduction

Quality of life factors continue to gain importance in residential location decisions as well as location decisions of firms that depend on highly qualified workers (Johnson and Rasker 1995; Love and Crompton 1999). With rising economic status, the scenic and recreational value of periurban landscapes is becoming increasingly important among these factors. As a consequence, measures to maintain landscape quality around growing urban centers are important on political agendas. This recent development is perhaps best illustrated by the large numbers of amenity-related referenda in highly developed regions of the United States and Switzerland (Kline 2006; Kline and Wichelns 1994; Kotchen and Powers 2006; Nelson et al. 2007; Press 2003; Schläpfer and Hanley 2003; Schläpfer and Witzig 2006; Solecki et al. 2004).

Measures to maintain periurban landscape quality can take various forms (e.g., Geoghegan 2002). Conservation of landscape quality may for instance be pursued through land-use zoning regulations (e.g., Deacon and Shapiro 1975), through public purchase of remaining open space (e.g., Kline and Wichelns 1994), or through incentives for the management of valued landscape features (Schläpfer and Hanley 2003). Alternative approaches to landscape management may differ in terms of the distribution of benefits. A better understanding of the distributions of these benefits is crucial for designing efficient policies (Cornes and Sandler 1996; Loomis 2000). Moreover, the distribution of perceived benefits may directly determine the political failure or success of a proposed policy, especially in political systems with referendum and initiative institutions. Kotchen and Powers (2006) begin to address this issue by examining the effect of the financing mechanism on public approval of open-space referenda.

For identifying the distribution of the perceived benefits of environmental policy measures, the analysis of voting decisions is particularly useful. Kahn and Matsusaka (1997) suggest that the analysis of environmental voting data does not suffer from the problems that arise with other methods. In particular, they note that the issues to be decided are real, the decisions are binding, the pre-election campaign period exposes the voter to variety of arguments and allows time for reflection, and there are no intervening political agents. Deacon and Shapiro (1975) developed the now-classic theoretical framework for analyzing voter demands for public goods.

To date, surprisingly few studies have used voting decisions in referenda to characterize the demand for environmental policies (Ascher and Steelman 2006). In the domain of land-use management decisions, hundreds of studies have used stated preference approaches to analyze the benefits of alternative public policies, while only a handful have analyzed voting behaviour in referenda. Most of these previous voter studies concerned with land-use management analyzed voter support for propositions to provide public money for conserving open space threatened by development (Kline 2006; Kline and Wichelns 1994; Kotchen and Powers 2006; Nelson et al. 2007).

Here, we characterize and compare voter support for two alternative approaches to the conservation of periurban landscape quality. Specifically, we analyze the results of a ballot initiative to designate a number of landscapes surrounding the highly developed urban center of Zurich as landscape reserves with an elevated protection status including elevated restrictions on land use and development. We then contrast the pattern of voter support for this ‘‘regulative’’ initiative with the support—among the same voter population—for a ‘‘financing’’ measure. The latter proposed to maintain landscape quality through increased public spending for the management of highly valued natural and historical landscape features.

We address the following main questions: (1) How is the demand for the regulation and financing policies related to local (mean) income? (2) How is the demand for the regulation and financing policies related to measures of landscape scarcity and quality as measured by variables for open space, major lakes and further landscape and historical-heritage amenities? (3) How does the demand for the regulation policy differ between municipalities including and not including (parts of) the landscape reserves?

The remainder of the article is organized as follows: The following sections present the conceptual framework, the data set, and the results. Two final sections offer discussion and conclusions.

Conceptual Framework

Our analysis follows previous work by Kline and Wichelns (1994) and Kahn and Matsusaka (1997), who characterize the demand for public goods by analyzing voter support for ballot propositions based on the economic framework by Deacon and Shapiro (1975). In the empirical model of Kahn and Matsusaka (1997), which we take as our starting point, the explanatory variables are (proxies for) a representative individual's income, price of the policy, and variables to account for variations in voter preferences. While the assumptions required to interpret the regression coefficients as parameters in the utility function of a representative individual are spelled out in Deacon and Shapiro (1975) and Dubin et al. (1992), the validity of these assumptions has not been established empirically, and the estimates should therefore be interpreted with caution (Kahn and Matsusaka 1997). From a policy perspective, however, this limitation is perhaps less important, as the interest is not primarily in the demand functions but in the determinants of aggregate vote proportions as a basis for designing acceptable policies.

The present application is distinct from previous analyses of environmental voting in several ways. First, instead of trying to characterize a generic demand function for conserving landscape quality, we propose that voter demands may depend on the conservation approach. We do this by comparing vote outcomes for a ''landscape regulation'' vote with those for a ''landscape financing'' vote held among the same population, using identical regression models. Second, the public goods affected by the examined ballot decisions follow distinct spatial patterns.[1] The spatial pattern must be expected to also affect the expected improvements of the public good. In order to properly identify the effects of other explanatory variables, the analysis must control for local variations in the quantity of the proposed public goods. A third conceptual issue concerns the correlations in aggregate vote regressions between income and proxies for the general ‘‘scarcity’’ of the environment, such as percentage open space or population density. This issue has not been explicitly addressed in previous voting studies on environmental policies. Here, we include ‘‘percentage open space’’ among the explanatory variables in all regressions to identify an income effect that is as clean as possible. Finally, in the present application, the variable for income reflects both voter income and costs of the policy because higher incomes also bear more of the costs of the regulation and financing measures, either through the progressive income tax schedule (in the financing measure) or through effects of regulation on the price of private goods (in the regulation measure).

The assumption in our analysis is that each voter registers his or her preference on a proposed change in the total quantity of a particular environmental good, and the vote is related to (1) individual income and costs, (2) environmental scarcity variables to account for variations in voter preferences, and (3) variables related to the quantity of the expected local public-good improvement. Hence, in addition to variables for income, costs, and variations in voter preferences, our analysis includes proxies for the expected local change of the proposed public good.

Data and Methods

The canton of Zurich is home to a long tradition of direct-democratic decision making dating back to 1865. Among all Swiss cantons, the Canton of Zurich currently has the most comprehensive set of direct-democratic rights. The present analyses are based on two referenda in the Swiss canton of Zurich: a landscape regulation initiative held in 2005 and a landscape amenities financing measure held in 1996. An important difference from open-space referenda in the United States is that the votes were concerned with conserving the quality, rather than quantity, of remaining open space.

The Landscape Regulation Initiative

The Swiss federal government maintains an inventory of nationally significant landscapes and natural monuments (Federal Executive Council 1998). However, this inventory does not imply an enhanced protection status except in the evaluation of federal infrastructure projects, unless the cantons that are responsible for nature and landscape protection pass specific laws and orders that are binding for local authorities and private landowners. The ‘‘landscape initiative’’ in the canton of Zurich proposed to designate all landscapes listed in the federal inventory as landscape reserves in the cantonal zoning plan. This proposition implied that the cantonal administration would have to pass legal orders for these areas containing detailed protection measures and regulations to be observed by the local authorities and landowners. In 2005, 40% of the inventory areas already enjoyed an enhanced protection status through cantonal protection orders. These protection orders were not contentious. The recent orders had been passed after generous negotiation with local landowners to secure broad public acceptance. The initiative thus demanded to similarly protect also the remaining 60% of the inventory areas.

As a special feature of Swiss direct-legislation institutions, a statement issued by the relevant executive body and a parliamentary debate on the proposed policy change are integral parts of the prereferendum process (e.g., Bisang 2004). The cantonal Executive Council argued that the canton’s landscape-inventory areas were adequately protected. The new protection measures would not allow the necessary flexibility in implementing the protection objectives. The cantonal parliament followed the Executive Council and decided (with 86 to 69 votes) to recommend voters reject the initiative. In the official voter information magazine for the vote on 5 June 2005, the initiative was presented on three and a half pages of text (including three photographs and one page presenting the position of the minority in the parliament and that of the initiative committee). The campaign opposing the initiative strongly focused on the ”regulation” character of the proposition. Their street poster campaign showed pictures of landscapes together with the words ‘‘walking prohibited,’’ ‘‘playing prohibited,’’ ‘‘horse-riding and golfing prohibited,’’ etc., although there was arguably little substance behind these claims (e.g., Neue Zürcher Zeitung, 14 May 2005, p. 53). The poster campaign of the initiative committee was equally visible, although rather uninformative (with smiling children lying in a meadow and the words: ‘‘Experience freedom. Yes to the landscape’’). The voters turned the initiative down with 56% no and 44% yes votes. Voter turnout was 56% (Cantonal Executive Council 2005).

The Landscape Amenities Financing Measure

In the canton of Zurich, private and public provision and management of nature reserves, traditional agricultural landscape elements (such as orchards, hedgerows), recreation areas, and historical heritage are financed through a public fund for nature and heritage protection (see Schläpfer and Hanley 2003). A proposition to increase the annual payments (from general tax revenues) into this fund in order to maintain the current landscape quality in the face of rising management costs was submitted to the voters in 1996. The ballot decision was between the current CHF 10–20 million annual funding and 20–30 million funding plus an empowerment of the parliament to allow up to 10 additional million annually to pay off debts of the fund. In the cantonal parliament the CHF 20–30 million annual funding passed with 82:74 votes before it was submitted to the popular referendum (Neue Zürcher Zeitung, 21 May 1996).[2] The street poster campaign in support of the increased funding showed an amalgamation of a tree and a human head, with the stem/neck cut halfway by an axe, designed by a well-known local painter. The opponents, including two of the four large parties, argued that the listing of conservation objects in the canton was handled too generously. The voters approved the proposition with 57% yes votes. Voter turnout was 29% (Office of the Parliament 1996).

The government authorities' preferences thus prevailed in both votes. However, it should be noted that many environmental votes at the cantonal and national levels were won against the executives and parliaments in recent years (e.g., Schläpfer and Witzig 2006). Following their usual position in environmental votes, the farmer organizations had opposed both propositions, although the financing measure also provided increased funding for conservation management by farmers (see Schläpfer and Hanley 2003). Public finances were scarce both in 1996 and in 2005, in contrast to some of the years in between and after these years. In summary, it seems fair to argue that the key difference between the votes is that the ''landscape initiative'' ballot was primarily seen by the public as a decision about ''additional regulation of the landscape,'' which infringed on individual freedom, while the ''landscape amenities financing'' measure was perceived as a decision about ''how much money should be spent on collective efforts to protect nature and landscape.'' In the latter, the distribution of the costs was given by the tax schedule (progressive taxes on income and wealth). In the former, the costs would be borne mainly by those individuals owning property within the proposed landscape reserves.

Definition of Variables and Data Sources

The voting data we examine are the aggregate vote proportions in 171 political municipalities of the canton of Zurich, which were provided by the cantonal Office of Statistics (Cantonal Executive Council 2005). These data are regressed on variables for individual income and costs, environmental scarcity, and quantity of the public-good improvement.

The variable for income and costs is the mean income per taxpayer (INCOME) in the voting districts (see Conceptual Framework section). The variable was computed from the total of reported net incomes in the tax period 1997=1998 and the number of taxpayers (‘‘normal cases and special cases with a direct federal tax burden’’), which are reported in the Federal Tax Administration’s publication of the tax period 1999=2000 (Federal Tax Administration 2004).

To account for variations in voter preferences we use two variables describing the ‘‘scarcity’’ of open landscapes. OPENSPACE is defined as the proportion of undeveloped land among the non-forested land area of the municipalities in 1994/96 as given by the Swiss land-use statistics (Federal Office of Statistics 1997).[3] This particular definition was chosen because open space in Switzerland tends to be perceived as the remaining nonforested area, which, for instance, is very low in urban municipalities although considerable forested area remains in some cases.[4] The variable LAKE is a dummy indicating whether the municipality is adjacent to one of the three major lakes of the canton.

The variables for the expected quantity of the public-good improvement are INVENTORY, AMENITY, and HERITAGE. INVENTORY indicates if a municipality comprises lands to which the landscape regulation initiative measure proposed to assign the elevated protection status and regulations of a landscape reserve. AMENITY and HERITAGE are measures of the local quantity of the landscape features affected (increased) by the amenities financing measure. AMENITY is defined as the percentage of land occupied by high-amenity landscape elements, which includes the land-cover categories orchards, hedgerows, groups of trees, small woods, shrubs, wetlands, shore vegetation, thin forest, forest strips, meadows, pastures, herbal vegetation and rocks, and sand or rubble. The variable is derived from the detailed Swiss area statistics (Federal Office of Statistics 1997).[5] HERITAGE is a dummy variable indicating whether the municipality has a townscape listed in the federal inventory of heritage townscapes (Federal Executive Council 2000). Municipalities with a heritage townscape or with a large extent of land amenities could expect to attract more of the funds. Descriptive statistics of these variables are presented in Table 1.

Table 1. Descriptive statistics of the variables used in regression analysis

Variable name	Description	Mean (SD)
INCOME	Mean income of taxpayers (in 1000 CHF)	36.7 (9.8)
OPENSPACE	Percentage of undeveloped land among non-forested land in a municipality	72.4 (16.8)
LAKE	Dummy for municipalities adjacent to major lake (1=yes, 0=no)	0.152 (0.360)
INVENTORY	Dummy for national landscape inventory (1=municipality comprises land designated to become (part of) a landscape reserve; 0=otherwise)	0.491 (0.501)
AMENITY	Percentage of land in high-amenity landscape elements	7.67 (3.78)
HERITAGE	Dummy for national inventory of heritage townscapes (1=municipality listed in the inventory; 0=otherwise)	0.456 (0.499)
$F_{\text{regulation}}$	Percentage approval of the ‘‘regulation’’ measure (landscape inventory initiative)	36.0 (7.02)
$F_{\text{financing}}$	Percentage approval of the ‘‘financing’’ measure (amenities financing measure)	47.4 (9.30)
$F_{\text{financing}}$-$F_{\text{regulation}}$	Difference of approval rates	11.5 (5.90)

Note. SD indicates the standard deviation.

Estimation

As in previous work based on the framework of Deacon and Shapiro (1975), we used the log odds of the proportion of yes votes as our dependent variable in ordinary least-squares regression to estimate the following base model for each vote:[6]

$$\begin{aligned} \text{logit } F = \ln\,[F/(1-F)] = \alpha + \beta_1(\text{INCOME}) + \beta_2(\text{OPENSPACE}) \\ + \beta_3(\text{LAKE}) + \beta_4(\text{INVENTORY}) + \beta_5(\text{AMENITY}) \\ + \beta_6(\text{HERITAGE}) + \varepsilon \end{aligned}$$

Indices $i = 1, \ldots, 171$ for the municipalities are omitted. In this equation F is the fraction of approving votes cast in municipality i; ε is a disturbance term; and β_1 to β_6 indicate the parameters to be estimated. The continuous variables were log-transformed to improve the distribution of the error term, which we examined by inspecting geographic maps of the residuals. To compare the determinants of the two votes, the same set of explanatory variables was also included in a regression of the difference between the two votes (logit $F_{\text{financing}}$ - logit $F_{\text{regulation}}$).

To examine how the patterns of approval differ between low-open-space (more ‘‘urban’’) and high-open-space (more ‘‘rural’’) and between high-income and low-income municipalities we split the sample at the median of these variables. We illustrate the functional form of the effects of income and open space in each vote by including the linear and quadratic terms and using these estimates to plot predicted values (cf. Kline 2006). Finally, we re-estimated all of the above models with dummies for the 14 districts of the canton to examine if the same patterns are also observed in this clustered analysis or if they can be explained by spatial autocorrelation within districts (Anselin 1988). Due to space limitations we cannot present all of the parallel models. However, we describe in the text how the results of the parallel models differ from those presented.

Results

Table 2 reports the base models for the regulation measure, for the financing measure, and for the approval difference. The model of the regulation measure (Table 2, left column) explains 47% of the observed variation in approval rates. Income is not a significant variable. The coefficient on OPENSPACE is negative and highly significant, while adjacency to a LAKE did not exert a significant effect. Approval rates in municipalities comprising lands targeted by the regulation measure (INVENTORY) were not different from those in municipalities not directly affected by the initiative. The amounts of land in high-amenity landscape features (AMENITY) and historical townscapes (HERITAGE) are positively associated with higher approval rates. The model of the ‘‘financing’’ measure (Table 2, second column) explains 53% of the observed variation. Here, the coefficient on INCOME is positive and highly significant. The remaining parameter estimates are similar to those in the regulation measure, although the coefficients indicate that the effects of OPENSPACE and AMENITY were somewhat stronger in the financing measure. The model to explain the approval difference between the two votes (Table 2, right column) reflects these differences; the effects of INCOME, OPENSPACE, and AMENITY are stronger in the financing proposition.

Given the strong effects of open space and income in these models, it is interesting to examine how the estimates differ between low-open-space (‘‘urban’’) and high-open-space (‘‘rural’’) municipalities and between high-income and low-income municipalities (Table 3). We first split the sample at the median of the open space variable (at the value 78.5) to obtain equal sample size and statistical power. In the regulation vote, income had a negative effect in the urban and a positive effect in the rural subsample. In the financing vote, INCOME is nonsignificant in the urban subsample and positive in the rural sample. The coefficients on OPENSPACE were all negative and significant, although the values cannot be directly compared between the two subsamples due to very different mean values of OPENSPACE. The remaining coefficients do not differ much between the urban and the rural subsample, except for the positive effect of LAKE on the regulation vote in the urban sample (for which we do not have a ready explanation). In the model of approval difference, the proportion of explained variance is much lower in the rural subsample (R^2=0.025) than in the urban subsample (R^2=0.229). Hence, the explanatory pattern of the two votes is very similar in the rural municipalities but not in the urban municipalities. When the sample was split at the median income (at the value 34.5), the pattern was very similar.[7] This suggests that the urban–rural difference in the income coefficient may partly reflect a difference between higher and lower levels of income.

Table 2. Linear model estimates for regulation approval, financing approval and approval difference

	Dependent variable		
Variable	logit ($F_{\text{regulation}}$)	logit ($F_{\text{financing}}$)	logit ($F_{\text{financing}}$)-logit ($F_{\text{regulation}}$)
Constant	-0.728*	-1.269***	-0.541
	(-1.89)	(-2.90)	(-1.42)
logINCOME	0.059	0.316***	0.256**
	(0.59)	(2.75)	(2.56)
logOPENSPACE	-0.240***	-0.282***	-0.042*
	(-9.37)	(-9.69)	(-1.67)
LAKE	0.073	0.005	-0.068
	(1.22)	(0.08)	(-1.14)
INVENTORY	0.019	-0.006	-0.024
	(0.49)	(-0.13)	(-0.64)
logAMENITY	0.068$_{*}$	0.166***	0.098**
	(1.74)	(3.76)	(2.55)
HERITAGE	0.081**	0.049	-0.032
	(2.20)	(1.18)	(-0.87)
N	171	171	171
R^2 adjusted	0.471	0.535	0.097

Note. Significance levels: * = significant at p<0.1, ** = significant at p<0.05, *** = significant at p<0.01. Numbers in parentheses are *t* statistics.

Table 3. Separate linear model estimates for urban and rural subsamples

	logit ($F_{regulation}$)		logit ($F_{financing}$)		logit ($F_{financing}$)-logit ($F_{regulation}$)	
Variable	Urban	Rural	Urban	Rural	Urban	Rural
Constant	0.505	-1.953**	-0.189	-2.734***	-0.695*	-0.781
	(1.61)	(-2.41)	(-0.43)	(-2.81)	(-1.84)	(-0.90)
logINCOME	-0.286***	0.534***	0.059	0.748***	0.344***	0.214
	(-3.55)	(2.70)	(0.53)	(3.14)	(3.54)	(1.01)
logOPENSPACE	-0.141***	-0.440***	-0.197***	-0.331***	-0.056	0.109
	(-4.95)	(-4.64)	(-5.01)	(-2.90)	(-1.62)	(1.07)
LAKE	0.177***	0.110	0.078	0.159	-0.099*	0.050
	(3.75)	(0.81)	(1.20)	(0.98)	(-1.74)	(0.34)
INVENTORY	0.040	-0.015	-0.025	0.023	-0.065	0.038
	(1.12)	(-0.26)	(-0.51)	(0.32)	(-1.50)	(0.60)
logAMENITY	0.056	0.038	0.086	0.163**	0.030	0.125**
	(1.26)	(0.73)	(1.41)	(2.61)	(0.56)	(2.25)
HERITAGE	0.049	0.055	-0.003	0.078	-0.052	0.023
	(1.41)	(0.99)	(-0.06)	(1.17)	(-1.24)	(0.39)
N	85	86	85	86	85	86
R^2 adjusted	0.423	0.403	0.320	0.355	0.229	0.025

Note. Significance levels: * = significant at $p<0.1$, ** = significant at $p<0.05$, *** = significant at $p<0.01$. Numbers in parentheses are *t* statistics.

Table 4. Quadratic model estimates for regulation approval and financing approval

	Dependent variable	
Variable	logit ($F_{\text{regulation}}$)	logit ($F_{\text{financing}}$)
Constant	-1.731***	-1.165***
	(-5.58)	(-3.14)
INCOME	0.037***	0.042***
	(3.44)	(3.22)
INCOME^2	-0.00039***	-0.00037***
	(-3.69)	(-2.91)
OPENSPACE	0.025***	0.017*
	(3.45)	(1.93)
OPENSPACE^2	-0.00028***	-0.00024***
	(-4.91)	(-3.47)
LAKE	0.133**	0.041
	(2.28)	(0.58)
INVENTORY	0.040	0.013
	(1.12)	(0.29)
AMENITY	0.002	0.017***
	(0.46)	(2.86)
HERITAGE	0.061*	0.043
	(1.74)	(1.02)
N	171	171
R^2 adjusted	0.531	0.543

Note. Significance levels: * = significant at p<0.1, ** = significant at p<0.05, *** = significant at p<0.01. Numbers in parentheses are *t* statistics.

To illustrate the functional form of the open-space and income effects we fitted linear and quadratic terms for these variables (Table 4) and used the estimated coefficients to compute predicted approval rates in the municipalities as a function of income and open space, holding other variables at mean values (Figures 1 and 2). Approval in the regulation vote reaches a maximum at about 40 to 50% open space and at about CHF 40,000 to 55,000 per-capita income. This functional form is consistent with the different coefficients in the separate models for the subsamples (see Table 3). In contrast, approval in the financing vote decreases with increasing open space (and increases with increasing income) over almost the entire range of the open space (income) variable. Whether AMENITY was linear or log-transformed in these models did not matter.

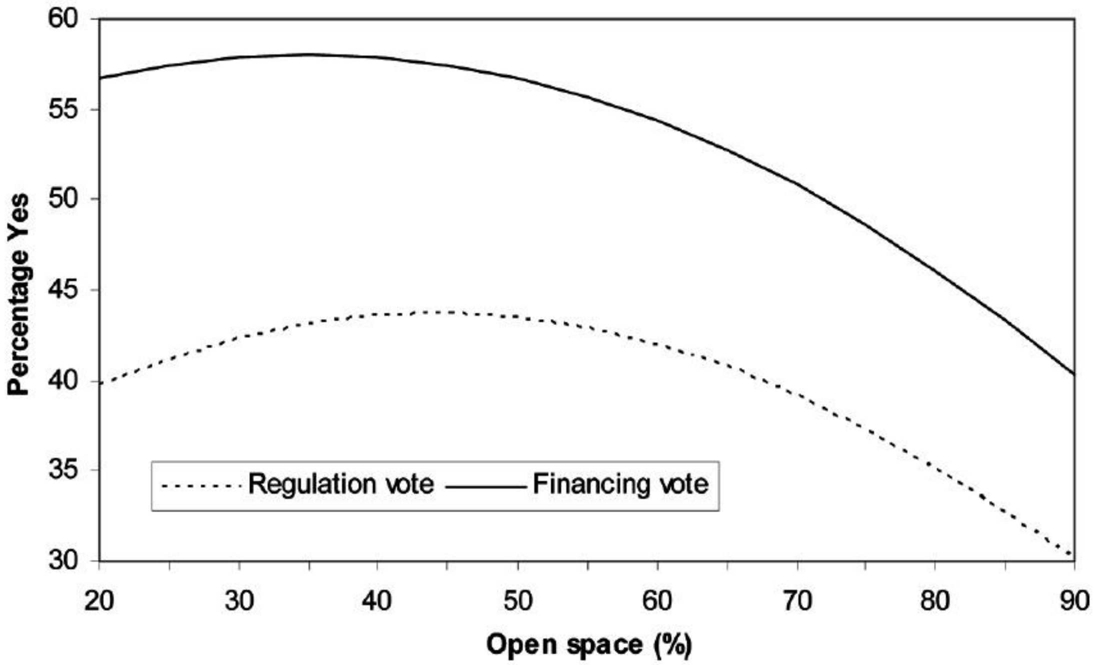


Figure 1. Predicted approval rates, by percentage remaining open space.

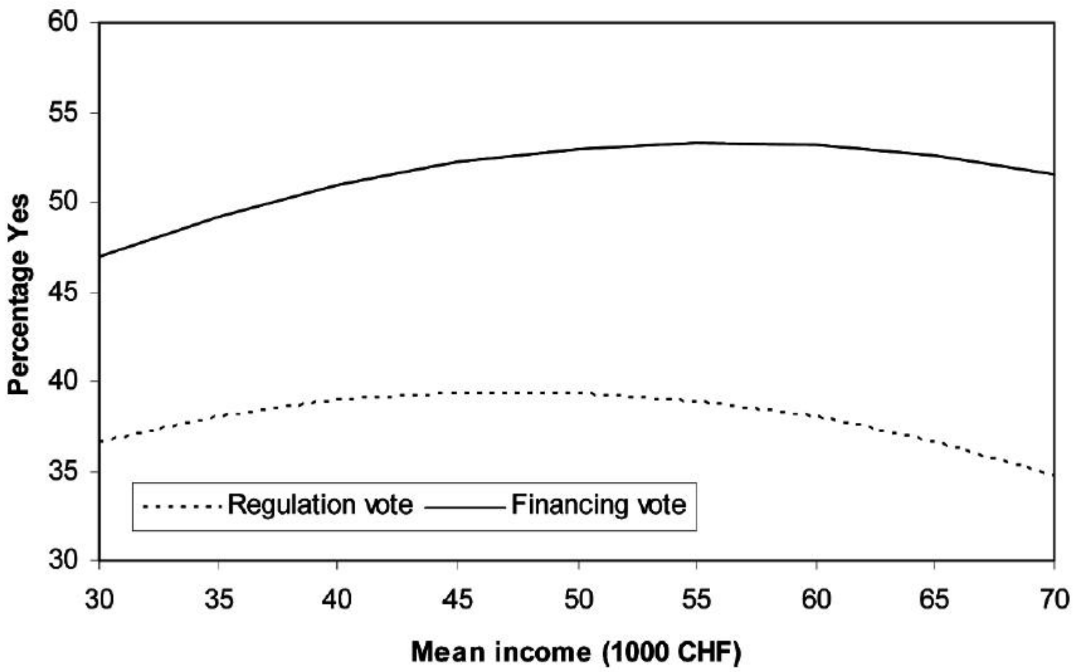


Figure 2. Predicted approval rates, by per capita income.

When district dummies were included in the models just described, this had only minor effects on the estimated effects of income and open space. In the rural subsample, the effect of income in the financing vote was not significant any more (t=1.22), and in the urban subsample the effect of open space in the difference model became weaker (t=1.42). In the quadratic models, the effects pattern remained the same. However, the effects of the variables controlling the levels of the proposed public goods were substantially altered. Significant effects in these clustered models may be cautiously interpreted as effects of local variation, whereas the nonclustered models also capture effects of only regional variation, which may potentially be confounded with variation in unknown omitted variables. In this clustered analysis, INVENTORY became significantly positive in all models for each vote, suggesting that the inventory did at least not negatively impact on the perception of the landscape protection proposals. AMENITY became non-significant in the base models indicating that the positive association of amenities with voting was found mainly at the regional rather than local level. Finally, HERITAGE was significant in all models with the full sample.

Discussion

Our results from voting decisions on the management of landscapes in Switzerland agree in several respects with those reported in the literature on open space preservation in the United States. First, our results show that voter support for policies to preserve landscape amenities is heavily driven by the amount of remaining open space (cf. Kline and Wichelns 1994). Scarcity of open space in growing urban centers thus appears to be a key variable not only in the demand for open space, but also in the demand for open-space quality. Second, the results suggest that demand increases with income but may level off or even decrease above a certain income level (cf. Kahn and Matsusaka 1997; Kline 2006). Third, the positive coefficient on the amenity and heritage variables in the financing vote appears to be similar to the positive effect of local sensitive resources reported by Kline and Wichelns (1994). It is tempting to explain these effects by greater perceived benefits from increased public financing for landscape amenities management in these municipalities. However, as the effect of amenities is also (weakly) significant in the ‘‘regulation’’ vote (see Table 2), this result could also be partly due to ‘‘Tiebout sorting,’’ whereby citizens with a particular taste for natural amenities self-select into jurisdictions providing high levels of these public goods (Tiebout 1956).[8]

The main additional insight from the present analysis is that the specific policy approach may affect the pattern of support for landscape management. In the canton of Zurich, which is characterized by a high economic status, a high rate of development, and a landscape with a still high recreational value, the demand for landscape financing increased with per-capita income in the more ‘‘rural’’ municipalities, but was nearly uniform across income levels in the more ‘‘urban’’ municipalities. In contrast, the demand for landscape regulation significantly decreased with increasing income among the urban municipalities. The estimated coefficients on the income variable differed both between the propositions (financing vs. regulation) and between the types of municipalities (more urban and/or higher income vs. more rural and/or lower income).

Previous studies have discussed the role of income on voter support at a very general level. Positive relationships between income and voter support for environmental propositions have been understood as evidence that ‘‘the environment’’ is a normal good (e.g., Kahn and Matsusaka 1997).[9] Our comparison of the two different votes highlights the possibility that the role of income in environmental policy votes may depend on the policy approach. One potential explanation for this result is that the different approaches imply different distributions of the costs. This interpretation would be consistent with Kotchen and Powers (2006), who found that the success of voting decisions on open space preservation depended on the type of financing mechanism.

Finally, our analysis of votes in a ballot initiative to more strictly protect a sample of aesthetically valued landscapes showed that the local populations in designated protection areas need not be less supportive of protection measures than the remaining population. This result can probably be explained by the low number of landowners (mainly farmers) who were directly affected by the proposed policy. The result contrasts with conventional wisdom holding that land-use regulations pit more rural regions affected by regulations against the urban regions, which benefit the most from the rural amenities.

As in all analyses of voting data, the voting outcomes reflect the preferences of the active voters. However, most studies by political scientists find that increasing or decreasing turnout has little impact on who wins and looses in elections (Shields and Goidel 1997). A further caveat regards the observational nature of the data. Although our interpretation of the voting patterns in terms of landscape financing versus regulation is based on important differences in the propositions and campaigns, we cannot rule out the possibility that the different patterns were at least partly caused by other factors. Further research comparing landscape financing and regulation decisions both within and across populations can help to clarify this issue. In addition, experimental studies such as Schläpfer and Schmitt (2007) can help to distinguish the roles of the content and the political process in collective decisions.

Conclusions

Our study contributes to the literature by demonstrating that the pattern of public support for state-wide (canton-wide) preservation of landscape amenities in highly developed regions may critically depend on the preservation ‘‘approach’’ - in our case, whether to preserve amenities through the public financing of valuable landscape elements or whether to impose land-use regulations. The comparison of the pattern in the ‘‘regulative’’ proposition with a recent ‘‘financing’’ proposition suggests that a simple classification of environmental public goods such as ‘‘landscape management’’ as either normal goods (where demand increases with income) or inferior goods (where demand decreases with income) based on the income coefficient in vote regressions is problematic. The issue is that the management approach may greatly matter for the distribution of the perceived benefits and costs across different incomes. This finding has potential implications for the design of successful landscape protection proposals. In the present Swiss context, the framing of the protection issue as a ‘‘financing proposition’’ appeared to be more compelling to the elites (the high incomes) than the regulation framing. We tentatively interpret that financing propositions that directly frame the issue as a question about what the landscape is ‘‘worth’’ may induce individuals to trade off income with landscape quality more directly than when a ‘‘regulation’’ framing activates entrenched ideological positions. Financing propositions may thus result in a more pronounced income effect and may thus be more easily won among elites with a high willingness to pay for landscape quality.

Notes

1. In previous studies regional patterns of the public good were relatively simple and were handled by including regional dummies - for example, distance to costal zones in a vote on development regulation in Deacon and Shapiro (1975) or a north–south disparity in decisions on water politics in Kahn and Matsusaka (1997).
2. The political process leading up to the vote involved several additional proposed budget levels. This process and the campaigns are described in more detail in Schläpfer and Hanley (2006).
3. The definition is based on the categories 1 for forest and categories 11, 12, 13, and 15 for developed land (of the BN 15 data set with 15 land cover types).

4. The definition is also consistent with the definition of recreational land in the cantonal Executive Order on Nature and Heritage Protection and on Recreation Lands (Cantonal Executive Council 2000). This order states (section V, paragraph 31) that ‘‘general’’ space for local recreation (as opposed to special recreation areas and parks), for which the target is 25–30m2 per inhabitant, should be ‘‘sufficiently sunny and calm, should offer views or other advantages of location and should be accessible through walking, hiking or bike paths.’’ A further difference from the notion of ‘‘open space’’ in the United States is that free access to all agricultural and forest land is granted by law as long as crops are not damaged.
5. Including the categories 76, 17, 18, 15, 16, 95, 96, 12, 13, 14, 81, 88, 97, and 99 (BN 74 data set with 74 land cover types).
6. We computed all models also with the untransformed dependent variable. The results were very similar. For instance, in Table 2 all significance levels remained the same, except for logAMENITIES in the first model where the *t* value was changed from 1.74 to 1.14.
7. The correlation coefficient between INCOME and OPENSPACE was -0.51.
8. Schläpfer and Hanley (2003) found this positive association with amenities also in environmental votes that were completely unrelated to local amenities.
9. From this perspective it is interesting to note that the income effect in the studies analyzed by Kahn and Matsusaka (1997) does not appear to be different between landscape ‘‘financing’’ (propositions 70, 130, and 180) and ‘‘regulation’’ votes (propositions 20 and 138). However, a problem in the analysis by Kahn and Matsusaka is that they did not include a variable for open space (or population density) in their models. To the extent mean income is correlated with population density, their income coefficients may ‘include’ effects of population density. Hence, it is difficult to say whether the type of measure did not matter for a more cleanly separated income effect.

References

Anselin, L. 1988. Spatial econometrics: Methods and models. Dordrecht, The Netherlands: Kluwer Academic Press.

Ascher, W. and T. Steelman. 2006. Valuation in the environmental policy process. Policy Sci. 39(1):73–90.

Bisang, K. 2004. Nature at the ballot box. Referendums and environmental policymaking in California and Switzerland. PhD dissertation, University of Zurich, Zurich, Switzerland.

Cantonal Executive Council. 2000. Verordnung über Staatsbeiträge für den Natur- und Heimatschutz und über kommunale Erholungsflächen. Zurich, Switzerland: Cantonal Printing Office.

Cantonal Executive Council. 2005. Beschluss des Regierungsrates über die Ergebnisse der kantonalen Volksabstimmung vom 5. Juni 2005. Zürcher Amtsblatt 17 June:613–625.

Cornes, R. and T. Sandler. 1996. The theory of externalities, public goods and club goods. Cambridge, MA: Cambridge University Press.

Deacon, R. and P. Shapiro. 1975. Private preference for collective goods revealed through voting on referenda. Am. Econ. Rev. 65(5):943–955.

Dubin, J. A., D. Kiewiet, D. Roderick, and C. Noussair. 1992. Voting on growth control measures: Preferences and strategies. Econ. Polit. 4:191–213.

Federal Executive Council. 1998. Verordnung über das Bundesinventar der Landschaften und Naturdenkmäler (VBLN). Bern, Switzerland: Federal Printing Office.

Federal Executive Council. 2000. Verordnung über das Bundesinventar der schützenswerten Ortsbilder der Schweiz (VISOS). Bern, Switzerland: Federal Printing Office.

Federal Office of Statistics. 1997. Land use statistics 1992/1997. GEOSTAT. Neuchâtel, Switzerland: Federal Office of Statistics.

Federal Tax Administration. 2004. Direkte Bundessteuer, Steuerperiode 1999/2000, Natürliche Personen. Federal Tax Administration, Bern, Switzerland. http://www.estv.admin.ch/d/dokumentation/zahlen_fakten/dbst_nat_k_1999_2000.htm (accessed 27 December 2007).

Geoghegan, J. 2002. The value of open spaces in residential land use. Land Use Policy 19(1):91–98.

Johnson, J. D. and R. Rasker. 1995. The role of economic and quality of life values in rural business location. J. Rural Stud. 11(4):405–416.

Kahn, M. E. and J. G. Matsusaka. 1997. Demand for environmental goods: Evidence from voting patterns on California initiatives. J. Law Econ. 40(1):137–173.

Kline, J. 2006. Public demand for preserving local open space. Society Nat. Resources 19(7):645–659.

Kline, J. and D. Wichelns. 1994. Using referendum data to characterize public support for purchasing development rights to farmland. Land Econ. 70(2):223–233.

Kotchen, M. J. and S. M. Powers. 2006. Explaining the appearance and success of voter referenda for open-space conservation. J. Environ. Econ. Manage. 52(1):373–390.

Loomis, J. B. 2000. Vertically summing public good demand curves: An empirical comparison of economic versus political jurisdictions. Land Econ. 76(2):312–321.

Love, L. L. and J. L. Crompton. 1999. The role of quality of life in business (re)location Decisions - Are economic developers, manufacturers and industrial real estate brokers operating on the same wave length? J. Business Res. 44(3):211–222.

Nelson, E., U. Michinori, and S. Polasky. 2007. Voting on open space: What explains the appearance and support of municipal-level open space conservation referenda in the United States? Ecol. Econ. 62(3–4):580–593.

Office of the Parliament. 1996. Beschluss des Büros des Kantonsrates über die Ergebnisse der kantonalen Volksabstimmung vom 22. September 1996. Zürcher Amtsblatt 4 October: 1641–1668.

Press, D. 2003. Who votes for natural resources in California. Society Nat. Resources 16(9):835–846.

Schläpfer, F. and M. Schmitt. 2007. Anchors, endorsements, and preferences A field experiment. Resource Energy Econ. 29(3):229–243.

Schläpfer, F. and N. Hanley. 2003. Do local landscape patterns affect the demand for landscape amenities protection? J. Agric. Econ. 54(1):21–34.

Schläpfer, F. and N. Hanley. 2006. Contingent valuation and collective choice. Kyklos 59(1):115–135.

Schläpfer, F. and P. J. Witzig. 2006. Public support for river restoration funding in relation to local river eco-morphology, population density, and mean income. Water Resources Res. 42: np. W12412 (article number).

Shields, T. G. and R. K. Goidel. 1997. Participation rates, socioeconomic class biases, and congressional elections: A crossvalidation. Am. J. Polit. Sci. 41(2):683–691.

Solecki, W. D., R. J. Mason, and S. Martin. 2004. The geography of voter support for open-space initiatives: A case study of New Jersey’s 1998 ballot measure. Social Sci. Q. 85(3):624–639.

Tiebout, C. 1956. A pure theory of local government expenditure. J. Polit. Econ. 64:416–424.

Chapter 3

The Role of Landscape Amenities in Regional Development: Evidence from Swiss Municipality Data

Fabian Waltert[1,2], Thomas Schulz[2] and Felix Schläpfer[3]

[1] Swiss Federal Institute for Forest, Snow and Landscape Research, Birmensdorf, Switzerland

[2] Institute of Evolutionary Biology and Environmental Studies, University of Zurich, Zurich, Switzerland

[3] Institute for Environmental Decisions, Swiss Federal Institute of Technology, Zurich, Switzerland

Abstract

Several recent regional and migration studies have identified landscape amenities as potentially important drivers of migration and local economic change in the United States. To date, these empirical approaches have not been applied to European data in spite of an impressive European cultural landscape heritage. Here, we apply the classic simultaneous equations model by Carlino and Mills (1987) to data from 2467 municipalities in Switzerland to examine how landscape amenities and related policies affected regional development along with other fiscal, demographic and infrastructure variables in the period from 1995 to 2005. In the population equation, the coefficients of the standard variables show a consistent pattern that confirms the findings of earlier work. Moreover, we find that population was positively affected by closeness to major lakes and by abundance of open space. However evidence on positive effects of small scaled high-quality landscape elements is limited. Furthermore, municipalities with heritage townscapes grew less than other, while the density of hiking trails had no significant effect. In the employment equation, employment was consistently affected by the traditional variables but not by the landscape amenity variables, except that employment grew less fast in municipalities that are part of an inventory of nationally significant landscapes. We conclude by discussing implications for the provision of landscape amenities in the context of agricultural and nature and heritage conservation policies and for debates about burden sharing between local, cantonal, and federal government.

JEL classification: Q2, Q5, R1, R2

Keywords: landscape amenities, migration, local development, regional economic modeling, employment, quality of life, geographic information system (GIS), spatial data

Introduction

With increasing environmental scarcities, policies to manage landscape amenities receive increasing interest among policy makers and the public. Landscape amenities are seen as a factor that contributes to the quality of life for local residents and may also benefit economic development by attracting tourists as well as industries depending on highly qualified workers. The increasing interest is evident, for instance, from a multitude of open space referenda and related debates about urban development in the U.S. and elsewhere (Nelson et al., 2007), from hedonic pricing studies that include amenity variables (Irwin, 2002), or from new agricultural policy programs specifically designed to remunerate farmers for managing landscape amenities.

In the U.S., the role of landscape amenities for local development has recently been explicitly examined by including landscape amenity variables in regional economic models in the tradition of Carlino and Mills (Carlino and Mills, 1987; Deller et al., 2001). Based on these studies, several researchers advocate the management of natural amenities as a development tool, and agricultural support policies were shifted from producer support to compensation for the provision of environmental amenities (e.g., Deller et al., 2001; Green, 2001; Feinerman and Komen, 2003; Fuller et al., 2005).

In Europe, the role of landscape amenities has not been investigated using regional economic simultaneous equation models (Waltert and Schläpfer, 2007). However, European applications are of interest for several reasons. First, European landscapes are different in that a rich and diverse pattern of “cultural landscapes” have evolved over hundreds of years, providing “identity” to populations that have remained less spatially mobile than those in the U.S. Second, rural development now constitutes an important motive for agricultural support programs in the European Union and its member countries. Finally, as in the U.S., many of these amenities are positive externalities of traditional agricultural land use which are now under pressure from urbanization and modern agricultural land use.

Thus, empirical research on the role of amenities for local development can contribute answers to several important current policy issues. It can provide a basis for policies to support landscape amenities including such as parks and natural reserves in peri-urban regions. It can also contribute to consistent agricultural policies by identifying whether landscape amenities indeed promote rural development. Finally, from a public finance perspective, the answers to these questions can indicate whether local municipalities benefit from the provision of landscape amenities and could therefore be expected to contribute themselves to their financing in a federal system.

In this paper, we apply the classic simultaneous equations model by Carlino and Mills to data from 2467 municipalities in Switzerland to examine how landscape amenities and related policies affected regional development along with other fiscal, demographic and infrastructure variables in the period from 1995 to 2005. While the fiscal and demographic variables are based on standard sources, the landscape variables were constructed from detailed geo-referenced data provided by the Swiss Federal Office of Topography and the Swiss Federal Statistical Office using a geographic information system.

The more general questions we address are: (1) how did the traditional locational factors affect population and employment? Here, we consider (i) initial conditions regarding population and employment; (ii) income; (iii) taxes; (iv) demographic composition; (v) economic structure (employment in different sectors); and (vi) distance to major cities and regional centers. (2) How did the abundance of amenities affect population and employment? Here, we consider (i) the abundance of open space; (ii) the abundance of a set of aesthetically valuable landscape features; (iii) distance to major lakes; and (iv) accessibility of the landscape for recreation (measured by density of hiking trails).

In addition, we address two questions relevant to specific current policy issues in Switzerland: (3) how did inclusion/exclusion in the inventories of landscapes and of national significance and townscapes of national significance affect local development?; and (4) how did the income support of Swiss agricultural policy affect local economic change both in general and in mountain regions?

Regarding the traditional local development factors our findings are in line with expectations and previous findings from the U.S. Regarding the role of amenities, we find that population was positively affected by closeness to major lakes and by the abundance of open space. However, evidence of positive effects of small-scaled high-value landscape features (including water shore vegetation, fens, orchards and hedgerows) is limited. Municipalities with heritage townscapes grew less than others, while the density of hiking trails had no significant effect. Employment was consistently affected by the traditional variables but not by the landscape amenity variables, except that employment grew less fast in municipalities that are part of an inventory of nationally significant landscapes.

The paper is composed of six sections. In the next section, theoretical aspects of previous research regarding the role of amenities in local development are reviewed and the model framework used for the empirical analysis is introduced. In section 3, the empirical model and the estimation method are described. Section 4 contains a description of the data used in the analysis. Section 5 provides the results and discussion of the model estimation. A final section presents conclusions and directions for further research.

Amenities and regional development: background

Amenities and migration: equilibrium versus disequilibrium view

Traditional micro theory of migration views migration as a reaction to spatial *disequilibria*. People migrate in order to reach a higher utility level. They react to regional differences in economic opportunities, for example by migrating from low- to high-wage regions. Hence, in the disequilibrium view, migration is basically a function of labour market variables; amenities have virtually no role as migration determinants. Since regional differentials are assumed to be disequilibrium situations, such differences in wages, rents or employment are sometimes referred to as *noncompensating differentials* (Hunt, 1993). Noncompensating differentials thus encourage migration as an equilibrating mechanism. A classical example of the disequilibrium view of migration theory is Sjaastad's (1962) human capital approach to migration theory, in which he states (p. 80): "[…] little has been done to determine the influence of migration as an equilibrating mechanism in a changing economy. The movements of migrants clearly are in the appropriate directions, but we do not know whether the numbers are sufficient to be efficient in correcting income disparities as they emerge. There is a strong presumption that they are not."[1]

In the late 1970s, an alternative model approach evolved, which has its roots in urban economics. In contrast to disequilibrium models, the *equilibrium* models allow for spatial differences in economic opportunities even in a spatial equilibrium. One of the first advocates of the equilibrium view was Graves, who explains the underlying rationale as follows (Graves, 1980, p. 227): "In this view of migration, market rents and wages are expected to adjust so as to leave utility constant over space. Hence, within a city rent differentials will emerge to remove any advantages associated with access to the centre, parks and the like, while across cities wages will be lower in desirable areas by an amount equivalent in utility to the amenities obtained by locating there. Migration, viewed in this way, takes place as a result of changes in demand for location-fixed amenities". Spatial differences in wages or economic opportunities are viewed as compensation for different amenity endowments. Hence, such differences are commonly referred to as *compensating*

[1] In spite of this disequilibrium rationale, Sjaastad already mentions amenities and disamenities such as climate, smog and congestion as potential "non-money returns to migration" (Sjaastad, 1962, p. 86). Greenwood (1975, 1985) and Hunt (1993) provide extensive reviews of disequilibrium migration models.

differentials, since they are of purely compensating nature and do not induce migration (Greenwood et al., 1991). The crucial explanatory variables in equilibrium migration models are amenity variables and factors that may lead to changes in demand and supply of amenities. These factors include growing real incomes (see Graves and Linneman, 1979) and changing relative prices, which lead the system to a new equilibrium. Such adjustment processes are believed to occur relatively quickly, unlike those associated with the disequilibrium approach, where the tendency towards equilibrium is assumed weaker and the migration process and factor markets are viewed as less efficient (Hunt, 1993).[2]

Whether equilibrium or disequilibrium models are more appropriate for modelling migration is at least partly an empirical issue. Hunt (1993) analyzes the empirical literature related to this question. He finds evidence in favour of both approaches. Both the amenity consumption and the job search motive seem to determine migration, while the relative importance of the two motives remains unclear. However, it is important to note that most early studies and some of the newer studies use relatively narrow amenity measures. It is often mainly one type of amenity, such as climate or water variables, or disamenity, such as air pollution and crime, that is modeled (e.g., Graves, 1976; Mueser and Graves, 1995; Clark and Murphy, 1996). Since the econometric evidence supports the idea that amenities are partially capitalized[3] in wages and rents and that migration is partly amenity driven, Hunt (1993) concludes that pure disequilibrium models are misspecified. On the other hand, in most studies, economic opportunity variables are found to be significant migration determinants, which implies spatial disequilibrium and inefficient markets (e.g., Porell, 1982; Greenwood and Hunt, 1989).

[2] For an extensive review of equilibrium models see Knapp and Graves (1989).

[3] A growing number of hedonic property price studies show that amenity variables are significant determinants of property prices and provide estimates of implicit prices of different amenity attributes (e.g., Garrod and Willis, 1992; Tyrväinen and Miettinen, 2000; Irwin and Bockstael, 2001; Netusil, 2005).

Simultaneous modeling of population and employment changes

To model the impact of amenity and other exogenous variables on multiple dependent variables such as population, employment and income change, as well as interactions of those dependent variables, system-of-equations models are often employed. Models of this type have traditionally been used to explore empirically whether people follow jobs or jobs follow people. One such example is the classic study by Steinnes and Fisher (1974), which explained intraurban location of residents and employment in a two-equation microeconomic model.

Carlino and Mills (1987) apply Steinnes and Fisher's intraurban system-of-equations model to an interregional context in order to explore the determinants of county growth in the U.S. This model has the following underlying assumptions on household and firm behavior[4]: Households and producers are geographically mobile and choose their location in order to maximize their utility or profits, respectively. Consumer utility is derived from goods and services as well as from non-market, location-specific amenities. Firms maximize their profits by optimizing production costs and market demand. The result is an adjustment process in which "firms enter and leave regions until profits are equalized among regions at competitive levels, and households migrate until utility levels are equalized at alternative locations" (Carlino and Mills, 1987, p. 40).

The framework by Carlino and Mills was advanced later, and several authors focussed on the role of amenities in the development process. Early contributions to this line of research used only regional dummies as proxies for location-specific amenities (e.g., Carlino and Mills, 1987) or climate variables and costal dummies (e.g., Clark and Murphy, 1996), and it was not until the 1990s that landscape amenities as defined in section 1 of this paper were considered in empirical research. Such extension may be essential for the empirical validity of the Carlino-Mills approach as stressed by Graves and

[4] Steinnes and Fisher (1974) provide a detailed microeconomic derivation of the system of equations and its underlying assumptions.

Mueser (1993, p. 78): The Carlino-Mills model "assumes that measured variables fully determine the ultimate equilibrium population. If there are any unmeasured stable differences between locations […], this imparts a systematic bias that will reduce the apparent speed of movement toward equilibrium." Graves and Mueser explicitly note natural amenities and land rents as essential and often wrongly omitted variables.

In response to Graves and Mueser's critique, several authors have started using modified versions of the Carlino and Mills model in recent years. Among the most influential works in this field of research is the study by Deller et al. (2001) who used a variety of sophisticated amenity measures and introduced a third variable for income change to the system. The general form of their model is (Deller et al., p. 355)

$$P^* = f\left(E^*, I^* \mid \Omega^P\right) \tag{1}$$

$$E^* = g\left(P^*, I^* \mid \Omega^E\right) \tag{2}$$

$$I^* = h\left(P^*, E^* \mid \Omega^I\right) \tag{3}$$

where the P^*, E^*, and I^* denote the equilibrium levels of population, employment, and per capita income. Ω^P, Ω^E, and Ω^I are a set of variables describing initial conditions and exogenous factors such as local economic conditions and several amenity measures. Deller et al. (2001) proposed a linear specification of this model, and they rearranged the terms in order to receive the changes ΔP, ΔE, and ΔI rather than equilibrium values on the left-hand side of the equations[5] (p. 356):

[5] Hunt (2006) uses the term *flow specification* for this model type as opposed to the *levels specification* (e.g., Carlino and Mills, 1987), which relates endogenous variables measured in levels instead of changes.

(4) $$\Delta P = \alpha_{0P} + \beta_{1P} P_{t-1} + \beta_{2P} E_{t-1} + \beta_{3P} I_{t-1} + \gamma_{1P} \Delta E + \gamma_{2P} \Delta I + \sum \delta_{IP} \Omega^{P}$$

(5) $$\Delta E = \alpha_{0E} + \beta_{1E} P_{t-1} + \beta_{2E} E_{t-1} + \beta_{3E} I_{t-1} + \gamma_{1E} \Delta P + \gamma_{2E} \Delta I + \sum \delta_{IE} \Omega^{E}$$

(6) $$\Delta I = \alpha_{0I} + \beta_{1I} P_{t-1} + \beta_{2I} E_{t-1} + \beta_{3I} I_{t-1} + \gamma_{1I} \Delta E + \gamma_{2I} \Delta P + \sum \delta_{II} \Omega^{I}$$

The endogenous variables in this system depend on the initial conditions $P_{t\text{-}1}$, $E_{t\text{-}1}$, and $I_{t\text{-}1}$, as well as on the changes of the two other dependent variables and on the vectors of exogenous factors Ω^P, Ω^E, and Ω^I.

Following Carlino and Mills (1987) and Deller et al. (2001) several papers employ the system-of-equations framework to the analysis of landscape amenity effects. Depending on whether the study focuses on total amenity effects or also on indirect effects resulting from the interplay of the endogenous variables, researchers estimate a reduced form by ordinary least squares (e.g., Deller et al., 2001) or apply simultaneous equations estimation methods such as two-stage least squares (e.g., Duffy-Deno, 1997) or the three-stage least squares technique (e.g., Lewis et al., 2003).

Empirical model

Following e.g. Carlino and Mills (1987) and Lewis et al. (2003), and using Swiss municipalities as our units of observation, we estimate a structural model where population and employment change are simultaneously determined. The empirical model is described by equations (7) and (8)

(7) $$\Delta POP = \eta_{0P} + \gamma_P \Delta EMPL + \lambda_P POP_0 + \omega_P \Omega_P + \varepsilon_P$$

(8) $$\Delta EMPL = \eta_{0E} + \gamma_E \Delta POP + \lambda_E EMPL_0 + \omega_E \Omega_E + \varepsilon_E$$

where η_0 are the intercepts, γ are the coefficients of the right-hand side endogenous variables, λ are the coefficients of the begin-of-period values, ω are the coefficients of the remaining independent variables Ω including amenities, and ε represents the error term of the respective equation. Hence, the following hypothesis is underlying this model: Population and employment change are determined by (1) historical growth patterns, (2) initial conditions and (3) amenities and other exogenous factors (demographic, economic and policy variables).

Two model specifications using the three stage least squares (3SLS) estimation procedure are estimated (see Table 2). Model 1 includes all amenity measures as independent variables in the population and the employment equation. In a second specification (model 2) – where justifiable by theory – nonsignificant variables were removed and interaction variables introduced as explained in Section 5.2. Model specification was also based on spatial residual plots (Appendix B).

The included variables for initial conditions and exogenous variables are detailed in the following section.

Data and sources

The sample includes 2467 out of 2740 Swiss municipalities, including 92 percent of the Swiss population. The remaining 273 municipalities were omitted because of missing data or because of structural breaks caused by territorial changes (e.g. municipality unions). The time period considered in the analysis is from 1995 to 2005. Where data from these start-of-period and end-of-period years were not available, data from the years closest to these years were used. The choice of variables is comparable to related studies such as Duffy-Deno (1997), Deller et al. (2001), Lewis et al. (2002, 2003), Hailu and Rosenberger (2004) and Kim et al. (2005). The factors hypothesized to influence local development can be summarized in three groups: (1) initial conditions and “traditional” variables including demographic factors, fiscal factors, local and business factors, (2) amenity-related policy variables, and (3) location-specific amenities. Descriptive statistics and descriptions of all variables used in the regression analysis as well as data references are provided in Table 1.

Dependent variables

The dependent variables of our two-equation system are percentage change of population *(ΔPOP)* and full time equivalent employment *(ΔEMPL)* between 1995 and 2005. Employment and population data were taken from the census of enterprises and the population census conducted by the Swiss Federal Statistical Office. Appendix A provides a map for both dependent variables in order to supply an overview of the spatial distribution of development. Population growth was above average in the periurban areas around the major cities of Zurich and Basel, as well as in suburban and certain rural parts of western Switzerland. On the other hand, widespread parts of the mountainous regions in southern and western Switzerland (Alps and Jura Mountains) experienced a decline in population. Employment concentrated around the metropolitan centres and in the periurban area between Zurich and Basel, while western Switzerland's and the mountainous regions' development was below average.

Initial conditions and traditional exogenous variables

The independent variables were chosen as begin-of-period values in order to reduce direction of causation identification problems (see Carlino and Mills, 1987). A first set of independent variables are the initial conditions on population *(POP1995)* and employment *(EMPL1995)*. Demographic variables used in the model are the share of foreigners (*FOREIGN*) and the percentage of the population that is younger than 20 or older than 64 years old (*NONACTIVE*). The latter partly determines a region's market size and consumption ability (Deller et al., 2001) as well as well as the fertility of the population.

Two labour-market related factors are the unemployment rate *(UNEMPL)* and the percentage of university degree holders *(UNIVERSITY)*. *EMPLS1* and *EMPLS3* represent the relative sizes of the primary and tertiary business sectors of the municipality economy. *INCTAX*, *TOTAL_AGRISUB* and *ECO_AGRISUB* are government variables. *INCTAX* represents the income tax burden (federal, cantonal and communal taxes) for a married taxpayer with two children and a gross income of CHF 70,000 as estimated on by means of data from the Swiss Federal Tax Administration and the tax administration offices of the Swiss cantons. In General, a high tax burden is considered to hinder economic as well as population growth.

Further local features are captured by the four variables *INCOME*, *LATIN*, *METRODIST and REGDIST*. The former represents the municipality per capita income at the start of the reference period. *LATIN* takes the value "1" in municipalities of Latin, respectively non-German-speaking Switzerland. This variable was included in the model in order to capture some particularities of those regions which feature for example employment levels that are systematically below average. Finally, the two GIS-constructed variables *METRODIST* and *REGDIST* indicate the accessibility of a municipality. While *REGDIST* – the road distance to the nearest regional center – indicates the local accessibility, *METRODIST* displays the road distance to the next major city which determines whether a municipality profits from agglomeration economies or is at least within commuting distance.

Amenity related policy variables

The variables *TOTAL_AGRISUB* and *ECO_AGRISUB* measure federal support payments (subsidies), which are directly transferred to farmers and are often a considerable fraction of a farmer's income. While all of these subsidies are conditional on basic environmental and ethical standards of production, a small fraction compensates farmers for specific ecological and animal-friendly production *(ECO_AGRISUB)*. *FEDLAND* reflects the percentage of municipality area listed in the Swiss Federal Inventory for Landscapes and Natural Monuments of National Significance. This inventory is relevant to decisions about national infrastructure but has no binding consequences for cantonal or local land use planning. Finally, our model contains a dummy variable indicating whether a municipality is listed in the National Inventory of Heritage Townscapes *(HERITAGE)*.

Amenity variables

Using GIS software on geo-referenced datasets, two landscape amenity measures and one amenity-related infrastructural measure were constructed. *OPENSPACE* indicates the percentage of non-forested municipality area not dedicated to settlement (including surroundings of buildings) or infrastructure. *AMENITY* represents the share of municipality land in high-quality open space. The attributes included in this variable are natural or near-natural landscape elements: water shore vegetation, fens, orchards, hedgerows, forest stripes and extensively farmed agricultural land.[6] Those elements are hypothesized to be a source of utility to locals and visitors in form of esthetical and recreational values. The area involved is considerably smaller than in the case of *OPENSPACE*.

LAKEDISTANCE represents the distance from the municipality center to the nearest lake. The recreational infrastructure measure *HIKING* indicates the municipality hiking trail density which serves as an indicator of the accessibility of the landscape for recreational uses.

[6] See Table 1

Results

Model 1

Population equation

The coefficient on the right-hand side endogenous variable *ΔEMPL* indicates that municipalities with higher employment growth in the 1995 to 2005 reference period also tended to grow faster in population (see Table 2). Start-of-period population levels played a significant role in determining future population growth. The negative coefficient for *POP1995* indicates patterns of convergence. Smaller municipalities grew faster than larger ones and rich locations attracted more in-migrants than poorer ones *(INCOME)*. The coefficient for the share of foreigners *(FOREIGN)* is negative and highly significant. Since foreigners tend to concentrate in urban areas, this variable may partly reflect the low dwelling vacancy rates as well as several disamenities associated with metropolitan centers such as pollution, traffic, noise exposure and crime.

As predicted by theory, a high tax burden dampens in-migration, the coefficient on *INCTAX* is highly significant and negative. Municipalities with high levels of income subsidies to farmers *(TOTAL_AGRISUB)* tended to show below average population dynamics. Those payments tend to be higher in remote rural areas and this effect may therefore partly reflect a general lower competitiveness and attractiveness of remote municipalities. Partly, this result may also reflect disamenities associated with intensive agricultural production, for example odor emission and reduction of biodiversity. Only a relatively small share of the income subsidies, the so-called *ecological direct payments* (1999: 15%, 2005: 20%) directly depend on extensive production methods and the provision of ecosystem services (Federal Office for Agriculture, 2003, 2007). The positive and highly significant coefficient on *ECO_AGRISUB* suggests that a higher share of ecological direct payments is associated with population growth, presumably by fostering landscape quality.

The coefficients on *LATIN* confirms that population and income growth were significantly higher in Latin Switzerland. *REGDIST* had the expected negative and highly significant effect on population growth, reflecting the limited attractiveness of remote regions as place of residence. Furthermore, population growth was declining with increasing distance to the nearest major metropolitan center (*METRO*).

The results for the amenity and amenity-related policy variables are nonuniform. The abundance of undeveloped areas *(OPENSPACE)* positively affects population growth. However this impact should not be interpreted as purely amenity-driven. Rather it reflects general advantages of a low population density such as a high supply of building plots and relatively low land prices, but also low pollution and noise levels. The coefficient for the second land-use variable*, AMENITY*, is positive but not significant. This suggests that there is no unambiguous evidence that municipalities attract migrants via a high landscape quality.[7] Considering that *AMENITY* consists of relatively small-scaled landscape elements, those features may be valued by adjacent households rather than by a broader population, leading to a compensation of amenity effects by higher property prices.[8]

Furthermore, no significant effect was found for land listed in the Federal Inventory for Landscapes and Natural Monuments of National Significance *(FEDLAND)*. Municipalities with heritage townscapes *(HERITAGE)* grew significantly slower than municipalities not listed in the heritage inventory. Those townscapes are legally protected which might hinder municipality development. In addition, it can be expected that the value of historical heritage is partly capitalized in housing prices. The coefficient on *LAKEDIST* is highly significant and negative which confirms the scenic and recreational amenity values of lakes. No effect was found for hiking trail density (*HIKING*).

[7] Model estimations with alternative *AMENITY* definitions support this finding. Significantly positive effects on population growth were only found when the variable is defined less strictly (e.g., agricultural open space) and hence larger areas are included.

[8] We renounced to control for property prices in our model because of direction of causation and data availability issues.

Employment equation

The coefficient on the right-hand side endogenous variable *ΔPOP* is positive but not significant in the employment equation, and start-of-period employment levels as well as the unemployment rate *(UNEMPL)* and the percentage of individuals with a university diploma *(UNIVERSITY)* had no significant effect on employment growth. However, municipalities with a high proportion of foreigners in 1995*(FOREIGN)* had a significantly higher job growth in the subsequent period. As expected, municipalities with a high proportion of minors and senior citizens *(NONACTIVE)* experienced lower growth in the number of jobs.

No significant effects were found for the employment shares of the economic sectors (*EMPLS1* and *EMPLS3*). A high accessibility and the proximity to major cities *(REGDIST* and *METRODIST)* foster employment growth. The coefficients are slightly higher in the population equation, suggesting that accessibility is even more important as a locational factor to firms compared to households.

While we found that richness in open space *(OPENSPACE)* significantly promotes population growth, no such effect was found for growth in jobs. Furthermore we found no relation between high-quality landscape features *(AMENITY)* and employment growth. Somewhat unexpectedly, *FEDLAND* has a negative effect on employment growth. Protection-worth landscapes might hinder economic development through land-use restrictions. On the other hand, those federally listed landscapes are not heavily protected and regulated and resource extractive industries are virtually inconsiderable in Switzerland. Therefore this finding may rather reflect the remoteness of many protection-worth areas. Unlike in the population equation, *HERITAGE* and *LAKEDIST* are not significant in the employment equation. The same is true for the hiking trail density.

Model 2

Table 2 contains a second model specification where the nonsignificant amenity variables were removed from the employment equation. Moreover, we introduced two interaction terms. Since for most variables the signs and significance levels did not change, we focus our attention to the newly introduced interactions and to the amenity and amenity-related policy variables.

In Switzerland, direct payments (subsidies) to farmers are partly motivated by the intention that those payments should prevent depopulation in rural and especially mountainous regions of the country (Federal Parliament, 1998). However, we found a negative and highly significant relation between the level of those subsidies and population change, which suggests that this political goal was not attained.

In order to test whether there is a positive effect if only mountainous regions – the regions suffering most from outflow - are considered, we constructed the interaction variable *TOTAL_AGRISUB*MOUNTAIN*. Indeed there is a positive coefficient on this interaction variable, however it is not significant. Hence, there is no evidence that the direct payments to farmers prevent depopulation in the mountainous regions of Switzerland.

In order to test the hypothesis that amenity effects depend on average income, we constructed the interaction variable *AMENITY*INC_HIGH*, where *INC_HIGH* takes the value "1" if a municipality belongs to the richest quartile of municipalities in reference to per capita income. The estimate implies that the effect of high-quality open space on population growth is significantly higher in high-income regions confirming the relatively high income elasticity of demand for landscape amenities.

While we found that abundance of open space and proximity to lakes attract people, no direct positive effects of amenities on job growth were observed. However, the positive and significant (model 2) coefficient on ΔPOP in the employment equation suggests that landscape amenities may promote employment growth indirectly by promoting population growth, which again is a significant determinant of employment growth. A drawback of our model is the fact that it does not control for rents, housing prices and local wage levels. As suggested by Roback (1982, 1988), richness in location-specific amenities may at least partly be compensated through lower wage levels and higher property prices. This may weaken the migration incentives to amenity-rich regions.

In order to check the quality of the model specification and particularly to check for spatial autocorrelation, maps of the regression residuals are provided in appendix B. Overall, clusters of municipalities with high and correlated residuals are relatively scarce, at least in the regions with higher population densities. In the Alps and Jura mountains, residuals tend to be negative and partially spatially correlated. This indicates that several features of those heterogeneous regions are not yet adequately represented in the estimated model. Together with spatial correlation of omitted variables, the non-consideration of spatial externalities of amenity and other variables between the municipalities may lead to autocorrelation of residuals and therefore induce inefficient estimations and biased standard errors.

Answers to research questions

The answers to our research questions (see section 1, p.3) can be summarized as follows:

(1) "Traditional" locational factors show a pattern consistent with earlier research. Population growth was positively affected by income and accessibility and partly by employment growth while a high percentage of immigrants and a high tax burden abated growth. Moreover, we observe convergence in population size between smaller and larger municipalities. Employment growth was fostered by population growth, the proportion of

foreigners and accessibility. Moreover, communities with a highly service-oriented sectoral structure and a small nonactive population tended to grow faster.

(2) We find that people are attracted to near-lake communities and communities with abundance of open space. The impact of visual landscape amenities measured by the proportion of high-quality landscape features is ambiguous. However, we show that this effect is rising with income level. No effect was found for the accessibility of landscape for recreation (measured by density of hiking trails). In contrast, landscape amenities do not directly foster employment change. However, amenity-induced immigration tends to promote employment growth.

(3) Municipalities with heritage townscapes had less population growth and municipalities that are part of an inventory of nationally significant landscapes had less employment growth than others.

(4) Although the income support of Swiss agricultural policy is partly motivated by alleviating depopulation in remote areas, we find a negative effect on population growth. However, we observe a positive effect of subsidies depending on ecological and sustainable production and the promotion of ecosystem services.

Conclusion

This paper provided structural-form estimates of a regional economic simultaneous equations model framework in the tradition of Carlino and Mills (1987) in order to shed light on the role of landscape amenities in local development. The results of this analysis with Swiss municipality data partially support earlier findings, that amenities are important determinants of local development – along with "classical" locational factors such as tax burden and accessibility. On average, Swiss regions with high abundance of open space and proximity to major lakes grew faster in population than other regions. However, job growth is only indirectly affected. Moreover, the evidence on positive effects of particularly valuable small-scaled landscape elements such as water shore vegetation, fens, orchards and hedgerows is week. While our results confirm the high income elasticity of demand for landscape amenities, their value may partly be compensated by higher property prices.

Municipalities with legally protected amenities (national heritage townscapes and landscapes of national significance) tended to grow less than those without these attributes. While this result may be in line with the political intentions of the national legislator, it also suggests that these municipalities do not themselves benefit from their local amenities. Local authorities do not have an incentive to implement these national policies. From a public finance perspective, this finding clearly indicates that the policies should be financed or compensated by the national government. Similar conclusions seem to apply to the agricultural subsidies. Our results are not fully in line with the political justification of those payments since they do not promote stabilization of the local economy. An exception is the special case of subsidies depending on ecological production standards.

Logical next steps toward a better understanding of amenity-driven development processes are the analysis of life-cycle effects[9] and personal characteristics. To understand the link between amenities and economic development, the following key questions must be answered: (1) what kind of individuals are attracted by what kind of amenities? And (2) what are the consequences of the socioeconomic characteristics of these individuals with regard to the regional economic development? A better understanding of amenity-driven development processes may encourage efficient integrated regional and environmental policies.

[9] Clark and Hunter (1992) found that while for young professionals and graduates labour market opportunities are the central factor when choosing a location, the importance of amenities rises with the age.

References

Carlino, G.A., Mills, E.S., 1987. The determinants of county growth. Journal of Regional Science 27(1):39-54.

Clark, D.E., Hunter, W.J., 1992. The impact of economic opportunity, amenities and fiscal factors on age-specific migration rates. Journal of Regional Science 32(3):349-365.

Clark, D.E., Murphy, C.A., 1996. Countywide employment and population growth: An analysis of the 1980s. Journal of Regional Science 36(2):235-256.

Deller, S.C., Tsai, T., Marcouiller, D.W., English, D.B.K., 2001. The role of amenities and quality of life in rural economic growth. American Journal of Agricultural Economics 83(2):352-365.

Duffy-Deno, K.T., 1997. Economic effect of endangered species preservation in the non-metropolitan west. Growth and Change 28(3):263-288.

Federal Office for Agriculture. Agricultural report 2003 (Agrarbericht 2003). Bern, 2003.

Federal Office for Agriculture. Agricultural report 2007 (Agrarbericht 2007). Bern, 2007.

Federal Parliament. Federal law on agriculture (Bundesgesetz über die Landwirtschaft, LwG). Federal Printing Office, Bern, 1998.

Feinerman, E., Komen, M.H.C., 2003. Agri-environmental instruments for an integrated rural policy: An economic analysis. Journal of Agricultural Economics 54(1):1-20.

Fuller, K., Monson, M., Ward, J., Mathews, L.G., 2005. Can nature drive economic growth? Review of agricultural economics 27(4):621-629.

Garrod, G., Willis, K., 1992. The amenity value of woodland in Great Britain: A comparison of economic estimates. Environmental and Resource Economics 2(4):415-434.

Graves, P.E., 1976. A reexamination of migration, economic opportunity, and the quality of life. Journal of Regional Science 16(1):107-112.

Graves, P.E., 1980. Migration and climate. Journal of Regional Science 20(2):227-237.

Graves, P.E., Linneman, P.D., 1979. Household migration: Theoretical and empirical results. Journal of Urban Economics 6(3):383-404.

Graves, P.E., Mueser, P.R., 1993. The role of equilibrium and disequilibrium in modelling regional growth and decline: A critical reassessment. Journal of Regional Science 33(1):69-84.

Green, G.P., 2001. Amenities and community economic development: Strategies for sustainability. Journal of Regional Analysis & Policy 31(2):61-75.

Greenwood, M.J., 1975. Research on internal migration in the United States: A survey. Journal of Economic Literature 75(2):397-433.

Greenwood, M.J., 1985. Human migration: Theory, models and empirical studies. Journal of Regional Science 25(4):521-544.

Greenwood, M.J., Hunt, G.L., 1989. Jobs versus amenities in the analysis of metropolitan migration. Journal of Urban Economics 25(1):1-16.

Greenwood, M.J., Hunt, G.L., Rickman, D.S., Treyz, G. I., 1991. Migration, regional equilibrium, and the estimation of compensating differentials. American Economic Review 81(5):1382-1390.

Hailu, Y.G., Rosenberger, R.S., 2004. Modeling migration effects on agricultural lands: A growth equilibrium model. Agricultural and Resource Economics Review 33(1):50-60.

Hunt, G.L., 1993. Equilibrium and disequilibrium in migration modelling. Regional Studies 27(4):341-349.

Hunt, G.L., 2006. Population-employment models: Stationarity, cointegration, and dynamic adjustments. Journal of Regional Science 46(2):205-244.

Irwin, E.G., Bockstael, N.E., 2001. The problem of identifying land use spillovers: Measuring the effects of open space on residential property values. American Journal of Agricultural Economics 83(3):698-704.

Irwin, E.G., 2002. The effects of open space on residential property values. Land Economics 78(4):465-480,

Kim, K., Marcouiller, D.W., Deller, S.C., 2005. Natural amenities and rural development: Understanding spatial and distributional attributes. Growth and Change 36(2):273-297.

Knapp, T.A., Graves, P.E., 1989. On the role of amenities in models of migration and regional development. Journal of Regional Science 29(1):71-87.

Lewis, D.J., Hunt, G.L., Plantinga, A.J., 2002. Public conservation land and employment growth in the northern forest region. Land Economics 78(2):245-259.

Lewis, D.J., Hunt, G.L., Plantinga, A.J., 2003. Does public lands policy affect local wage growth? Growth and Change 34(1):64-86.

Mueser, P.R., Graves, P.E., 1995. Examining the role of economic opportunity and amenities in explaining population redistribution. Journal of Urban Economics 37(2):176-200.

Nelson, E., Uwasu, M., Polasky, S., 2007. Voting on open space: What explains the appearance and support of municipal-level open space conservation referenda in the United States? Ecological Economics 62(3-4):580-593.

Netusil, N.R., 2005. The effect of environmental zoning and amenities on property values: Portland, Oregon. Land Economics 81(2):227-246.

Porell, F.W., 1982. Intermetropolitan migration and quality of life. Journal of Regional Science 22(2):137-158.

Roback, J., 1982. Wages, rents, and the quality of life. Journal of Political Economy 90(6):1257-1278.

Roback, J., 1988. Wages, rents, and amenities: Differences among workers and regions. Economic Inquiry 26(1):23-41.

Sjaastad, L.A., 1962. The costs and returns of human migration. Journal of Political Economy 70(5), Part 2: Investment in human beings, 80-93.

Steinnes, D.N., Fisher, W.D., 1974. An econometric model of intraurban location. Journal of Regional Science 14(1):65-80.

Tyrväinen, L., Miettinen, A., 2000. Property prices and urban forest amenities. Journal of Environmental Economics and Management 39(2):205-223.

Waltert, F., Schläpfer, S., 2007. The role of landscape amenities in regional development: A survey of migration, regional economic and hedonic pricing models. Working Paper No. 0710, Socioeconomic Institute, University of Zurich.

Table 1 Descriptive statistics of the variables used in regression analysis

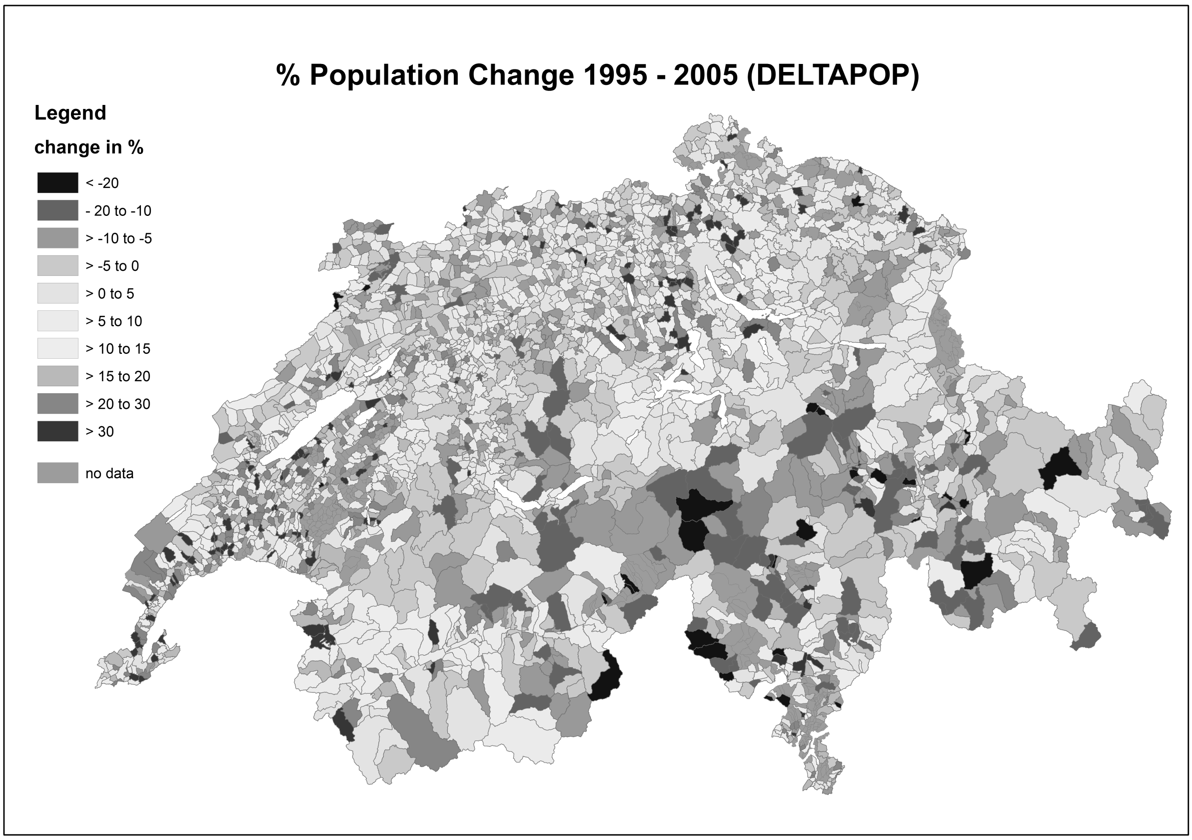
Variable name	Description	Source[a]	Mean	St. Dev.
ΔPOP	Change in permanent resident population, 1995-2005, in percent	A	6.87	12.87
ΔEMPL	Change in full time equivalent employment, 1995-2005, in percent	C	-5.79	26.29
POP1995	Permanent resident population, 1995	A	2601.77	10153.51
EMPL1995	Full time equivalent employment, 1995	C	1208.30	7529.58
INCOME	Per capita net income, 1995, in CHF 1000	E, A	26.89	7.33
FOREIGN	Foreigners, 1995, in percent of total resident population	A	10.49	8.32
NONACTIVE	Population that is younger than 20 years or older than 64 years, 1990, in percent	B	40.25	4.61
INCTAX	Tax burden for a married taxpayer with a gross income of CHF 70,000, 1995, in percent[c]	E	10.18	1.71
UNEMPL	Unemployment rate, 1990, in percent of total work force	B	1.61	1.32
UNIVERSITY	Persons with a university diploma, 1990, in percent of residents between the age of 25 and 64	B	4.11	3.81
EMPLS1	Employment in the primary sector, 1995, in percent	C	26.46	23.16
EMPLS3	Employment in the tertiary sector, 1995, in percent	C	42.48	19.43
LATIN	Dummy for municipalities with majority of people with French, Italian or Rhaeto-Romanic first language (1 = yes, 0 = no), 1990	B	0.39	0.49
METRODIST	Road distance to the nearest major city[b], in meters	G	58176.67	51177.30
REGDIST	Road distance to the nearest regional centre, in meters	G	15516.91	10491.80
TOTAL_AGRISUB	Federal subsidies to farmers (general payments and payments for ecological production), 1999, in CHF per capita	F, A	1018.71	1272.21
ECO_AGRISUB	Federal subsidies to farmers (payments for ecological production), 1999, in percent of TOTAL_AGRISUB	F, A	14.28	6.83
FEDLAND	Percent of municipality area listed in the Federal Inventory for Landscapes and Natural Monuments of National Significance (BLN), 2004	J, H	12.24	24.84
HERITAGE	Dummy for national inventory of heritage townscapes (1=municipality listed in inventory, 0 otherwise)	I	0.32	0.47
OPENSPACE	Open space[d], in percent of non-forested municipality area	D	84.58	13.39
AMENITY	Percent of municipality area in near-natural landscape elements[e]	D	15.34	8.88
LAKEDIST	Distance to nearest lake, in meters	H	13487.87	10922.77
HIKING	Hiking trail density, in meters per square kilometer	H	2269.88	1033.17
MOUNTAIN	Dummy for municipalities with altitude[f] greater than 900 meter, (1 = yes, 0 = no)	H	0.10	0.31
INC_HIGH	Dummy for municipalities belonging to the 25 percent with highest per capita income (1 = yes, 0 = no)	E	0.25	0.43

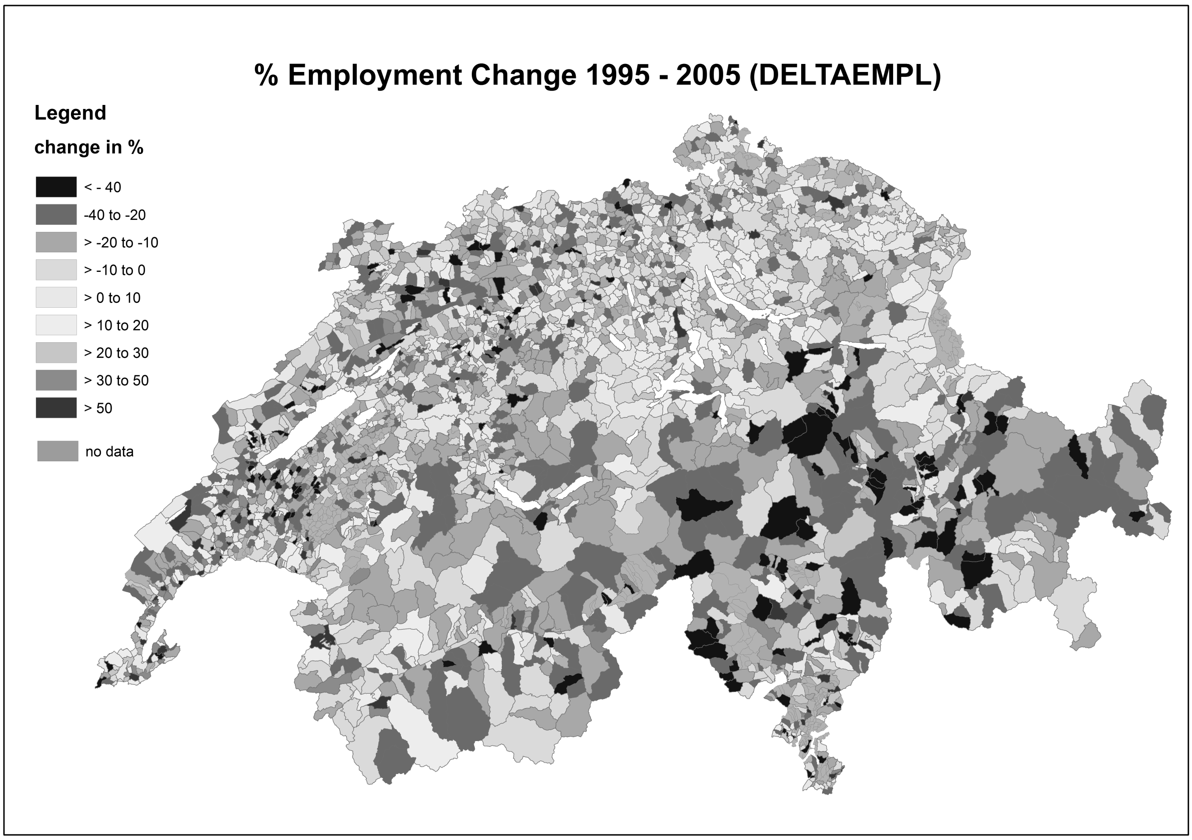
[a] Data sources: A: Swiss Federal Statistical Office; B: Swiss Federal Statistical Office (Population Census); C: Swiss Federal Statistical Office (Census of Enterprises); D: Swiss Federal Statistical Office (land use statistics 1992/97), E: Swiss Federal Tax Administration and tax administration offices of the Swiss cantons; F: Swiss Federal Office for Agriculture; G: ETH Zurich, Institute for Transport Planning and Systems IVT; H: Federal Office of Topography (Swisstopo), I: Federal Executive Council: Regulation on the national inventory of heritage townscapes (VISOS), J: Federal Office for the Environment.
[b] Major cities: Zurich, Geneva, Basel, Bern and Lausanne.
[c] Since the tax burden data is only available for municipalities with more than 2000 inhabitants the tax burden of smaller communities was estimated using data on tax rates from the tax administration offices of the Swiss cantons.
[d] Contains the categories 3,4, 5, 6, 7, 8, 9, 10, 14 of the Swiss land use statistics 1992/97 (aggregation NOAS92_15).
[e] Contains the categories 13, 14, 17, 18, 73, 76, 77, 82, 87, 95, 96 of the Swiss land use statistics 1992/97 (basic categories).
[f] Altitude at the lowest point of the municipality area.

Table 2 3SLS estimation results for change in population and employment (t-values in parentheses)

Variable name	Model 1		Model 2	
	ΔPOP	ΔEMPL	ΔPOP	ΔEMPL
Intercept	2.81719 (0.67070)	25.20398** (2.52129)	5.38714 (1.34141)	8.49106 (1.11051)
⊿POP (instrument)		0.29858 (1.60774)		0.45652*** (3.04518)
⊿EMPL (instrument)	0.22084* (1.93354)		0.11109 (0.96327)	
POP1995	-0.00006** (-2.28708)		-0.00007*** (-2.81648)	
EMPL1995		-0.00006 (-0.78225)		-0.00002 (-0.34277)
INCOME	0.34108*** (8.09545)		0.24457*** (5.45442)	
FOREIGN	-0.22675*** (-4.95628)	0.19214** (2.02309)	-0.20005*** (-4.54185)	0.27068*** (3.14928)
NONACTIVE		-0.54404*** (-3.21142)		-0.36417** (-2.30646)
INCTAX	-0.53073*** (-2.93925)		-0.36921** (-2.03222)	
UNEMPL		-0.04547 (-0.12516)		-0.18134 (-0.46256)
UNIVERSITY		0.03043 (0.17704)		-0.03512 (-0.20397)
EMPLS1		-0.04911 (-1.60966)		-0.06492** (-2.05322)
EMPLS3		0.04217 (1.36242)		0.05554* (1.70139)
LATIN	5.39213*** (8.35231)	0.00625 (0.00439)	5.43126*** (8.93416)	-0.48111 (-0.35951)
METRODIST	-0.00003*** (-2.98354)	-0.00004*** (-3.24099)	-0.00003*** (-3.50652)	-0.00005*** (-3.44735)
REGDIST	-0.00010*** (-2.74714)	-0.00016** (-2.42339)	-0.00013*** (-3.64214)	-0.00015** (-2.57519)
TOTAL_AGRISUB	-0.00090*** (-2.62242)		-0.00121*** (-3.15338)	
TOTAL_AGRISUB*MOUNTAIN			0.00038 (1.21048)	
ECO_AGRISUB	0.17946*** (4.29119)		0.17738*** (4.34074)	
FEDLAND	0.01046 (0.96582)	-0.04019* (-1.90694)	0.00637 (0.61922)	-0.04637** (-2.25571)
HERITAGE	-1.47381*** (-2.67230)	-0.27897 (-0.24418)	-1.67426*** (-3.39570)	
OPENSPACE	0.06209** (2.05657)	-0.07455 (-1.32835)	0.04799* (1.79100)	
AMENITY	0.03822 (1.27537)	0.03495 (0.55588)	0.00534 (0.19466)	
AMENITY*INC_HIGH			0.21741*** (4.66812)	
LAKEDIST	-0.00009*** (-3.61229)	-0.00002 (-0.40651)	-0.00009*** (-4.22378)	
HIKING	-0.00036 (-1.26995)	-0.00088 (-1.58452)	-0.00058** (-2.23252)	
Number of Observations	2467	2467	2467	2467
Adj. R-Squared OLS	0.256	0.109	0.264	0.109
McElroy R-Squared (System)	0.397		0.327	

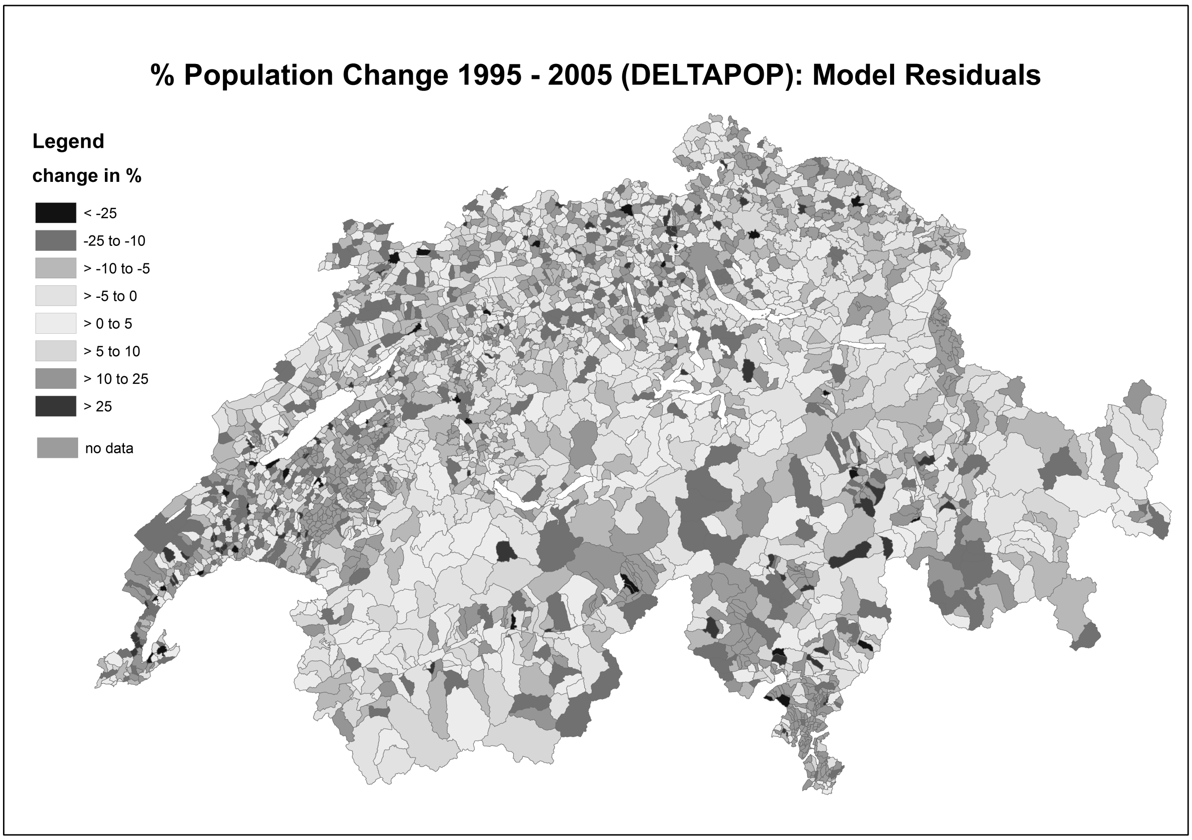
Appendix A: maps of dependent variables

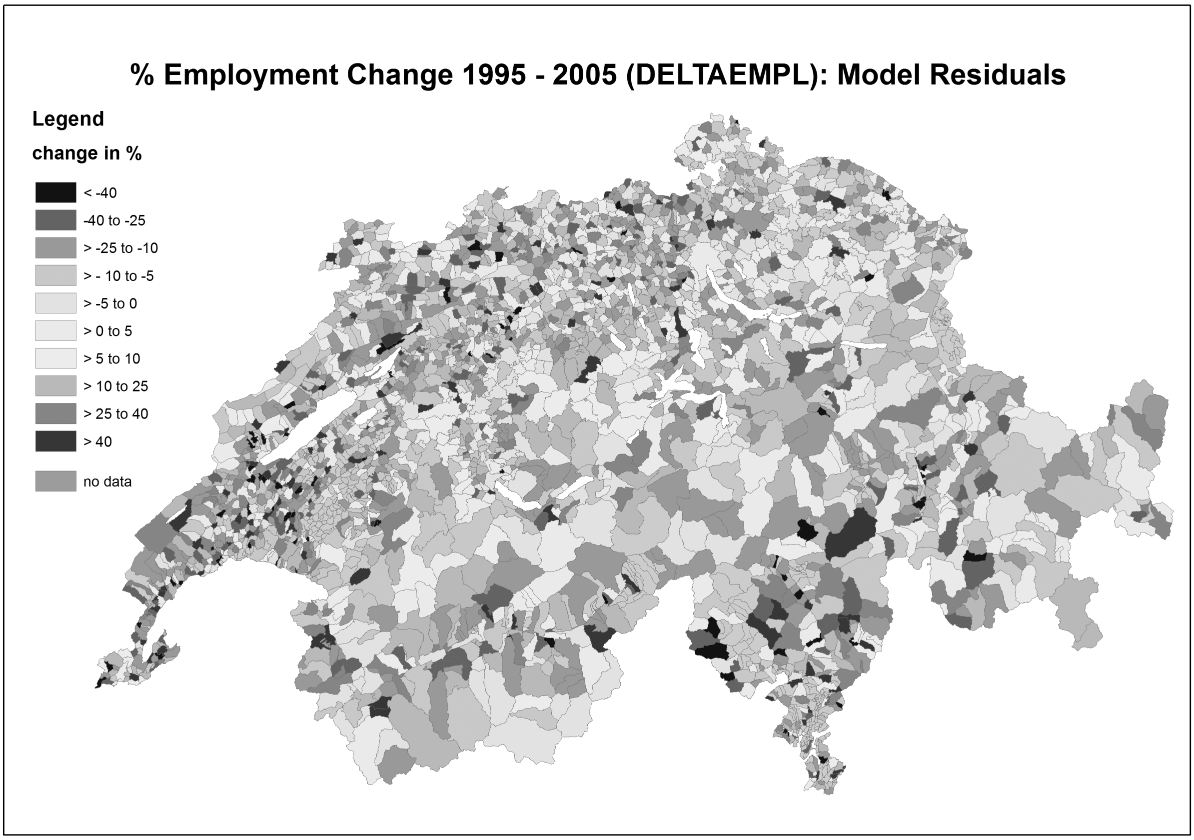




.

Appendix B: maps of regression residuals of Model 2





Chapter 4

How Local Landscape Resources affect Property Prices: Evidence from a Hedonic Pricing Model

Thomas Schulz[1], Fabian Waltert[12] and Felix Schläpfer[3]

[1] Institute of Evolutionary Biology and Environmental Studies, University of Zurich, Zurich, Switzerland

[2] Swiss Federal Institute for Forest, Snow and Landscape Research, Birmensdorf, Switzerland

[3] Institute for Environmental Decisions, Swiss Federal Institute of Technology, Zurich, Switzerland

Abstract

Switzerland is an excellent showcase for studying how local landscape resources affect property prices. This is due to the large spatial heterogeneity of local landscape amenities and the nation-wide availability of landscape data. In this paper we estimate the value of landscape resources as reflected in apartment rental prices by using the hedonic pricing method. For this purpose we analyze a cross section of 80814 apartments in 956 Swiss communities. Along with other property attributes, our analysis includes GIS-based municipality-level variables which characterize location-specific amenities and other neighborhood features. The importance of our study is that we provide the first nation-wide approach using the hedonic pricing method in the environmental economic literature. We also use a much broader set of explanatory variables than any other study before. Our results show that several aspects of landscape and townscape management as well as natural amenities have a strong impact on property prices. Specifically a southern exposition, lake view, open space, historical heritage and land for recreational activities play an important role in determining the attractiveness of a location. Furthermore our results support the idea that settlement pressure which is also reflected in property prices tends to increase the population’s sensitivity towards landscape changes.

Keywords: amenity, hedonic pricing method, landscape resources, landscape management, open space

JEL classification: Q1, Q2, Q5, R1, R2

We are grateful to Julian Baker and Randy Walsh for their helpful comments and to Marco Salvi for preparing the property data.

Introduction

Urbanization and loss of natural environment lead to a shortage of landscape resources. Landscape resources provide many environmental and social benefits. The quantification of these benefits helps to improve political decisions concerning provision, management and financing of landscape-related amenities at a municipal, regional and national level. A better knowledge of "how landscape resources affect the local economy" contributes to a more sustainable use of publicly accessible environmental goods.

The hedonic pricing approach is an excellent method to estimate environmental benefits. "The basic assumption of the hedonic pricing method is that people's valuation of environmental attributes can be inferred from the amount they are willing to pay for these attributes through the housing market" (Hanley et al. 2001).

As early as 1974, Rosen formulated the first theoretical framework for the hedonic pricing approach, and Freeman (1974) applied the framework for measuring negative impacts on property value from air pollution. After initial studies of the relationship between air pollution and property values (Freeman 1974, Nelson 1978, Palmquist 1983) numerous studies on forestry and agricultural impacts on property prices followed (e.g., Anderson and Cordell 1988, Garrod and Willis 1992a, Garrod and Willis 1992b, Tyrväinen 1997, Palmquist et al. 1997, Tyrväinen and Miettinen 2000, Le Goffe 2000, Kim and Johnson 2002). These studies measured the amenity values of landscape features such as woodland, trees, forest, grassland, wetland and pastureland. Studies by Riddel (2001), Geoghegan (2002), Smith (2002), Irwin (2002), Marshall (2004), Walsh (2007) and Cho et al. (2008) further integrated the amenity variable "open space" in their models to explain the scarcity of landscape resources caused by urbanization processes.

All these studies focus only on one particular landscape resource to measure the environmental benefits and they estimate the property values in spatially limited locations only. In contrast to these studies we assume that different natural amenities[1] influence each other. In combination they affect property prices stronger than alone. We use a larger set of landscape variables[2] to measure the multidimensional impacts on property prices. The importance of our study is that we provide the first nation-wide hedonic pricing approach in the environmental economic literature. We also use a much broader set of explanatory variables than any other study before. They include property characteristics, landscape and townscape management, natural amenities, accessibility characteristics and tourism infrastructure, as well as fiscal conditions and socio-demographical characteristics. Our results highlight the benefits of landscape resources as valued by local residents.

Due to a large variation in local landscape amenities and a multitude of landscape data, Switzerland is an excellent case for studying how local landscape resources affect property prices. We use a cross section of housing prices gathered from 80814 observations in 956 Swiss communities. Along with landscape amenities we included a comprehensive set of controls including regional dummies for major Swiss regions. The sizeable dataset allows us to estimate hedonic pricing functions for the whole area of Switzerland with focus on the impact of landscape resources and management. New GIS[3] technologies allow extensive spatial analysis with high-resolution area-wide data.

This paper consists of seven sections. In the second section the theoretical and methodological framework is introduced. It is followed by a detailed report about the analyzed dataset in section three. The empirical models used are described in section four. Results of our analysis are presented in section five and discussed in section six. Finally, conclusions are provided in section seven.

[1] See Table 1: Definition of variables and summary statistics
[2] See Table 1: Definition of variables and summary statistics
[3] GIS: Geographical Information System

Local landscape benefits and hedonic models

Benefits of local landscape

Local landscape resources provide many economic and environmental benefits. The value of these benefits can be subclassified into three main value components: use values, option values, and nonuse values (Tietenberg, 2006). Use values reflect the direct use, option use implicates the possible future use and nonuse values reflect unused but existent environmental resources. Our approach focuses on use values, which imply the direct use of landscape resources.

There is no publication in environmental economic literature that provides a complex view on local landscape benefits and the interactions of the different landscape elements such as water, soil, vegetation, climate, geomorphology, human impacts etc. Most publications focus on use values by measuring the benefits of few local landscape resources such as wetland, green space and woodland. For instance, Costanza et al. (1989) emphasise three categories of benefits of wetland: commercial fishing, recreation and storm protection. Barbier (1993) found that sustainable use of local wetlands in the tropics provide local economic benefits. Later, Boyd and Wainger (2002) showed that wetland ecosystem services provide environmental benefits. Furthermore, Burel and Baudry (1995) found that hedgerow network landscapes considered as greenways provide agronomic, ecological, aesthetic and cultural benefits. Similarly, the study by Ndubisi et al. (1995) analyzed the ecological and environmental benefits from greenway corridors. Additionally, Fabos (1995) found that greenway movement influences recreational benefits. Finally, Tyrväinen (1997) and Tyrväinen et al. (2007) pointed out that urban forest and green areas provide social, economic and environmental benefits, and Medley et al. (2003) showed the historical change in forest cover and the therewith linked economic benefit change for land owners.

In our model we have examined the different landscape elements as complex formations that influence each other. Hence, we can show the economic and environmental benefits of landscape through complexly structured use values.

Hedonic models

The theoretical and methodical basis of the hedonic pricing approach was established by Rosen (1974) and Freeman (1974, 1979) who also showed how this approach can be used for studies of the relationship between environmental amenities and property value. The hedonic pricing technique consists of two steps: (1) The hedonic price equation can be used to estimate marginal implicit prices of amenities and (2) the implicit prices allow to estimate inverse demand functions.[4] The hedonic price function depends on the observed units of demand.

Brawn and Rosen (1982) enhanced Rosen’s (1974) first approach. They developed a two step model with a demand and a supply function, paying particular attention to marginal price. They discovered that constructed marginal attribute prices do not play the same role as directly observed available prices. Epple (1987) used a similar approach for different products and showed that important unmeasured characteristics affect biased estimates.

Atkinson (1987) tested the robustness of hedonic property value studies with a Bayesian approach. He pointed out that hedonic models with systematic use of prior information can break the collinearity deadlock in the data. Later, Cropper et al. (1988) examined how errors in measuring marginal prices vary with the specification of the hedonic price function and showed that linear and quadratic Box-Cox forms perform best for completely observed attributes. Also, Graves et al. (1988) tested the robustness of

[4] Step 2 is omitted in many papers using the HP method.

hedonic price estimations and confirmed that the quadratic functional Box-Cox form affected the results best.

Bartik (1987) enhanced Rosen’s (1974) two-stage least square and Freeman’s (1974) ordinary least square estimation method with attention to the marginal bid function for the physical conditions of a neighborhood. He found that marginal prices and sizes exist when households have a non-linear budget constraint. Can (1992) also considered neighborhood effects and adjacency effects in his model specifications and showed that the consideration of these effects led to the inclusion of spatial dependence. Moreover, Freeman (1993) enhanced his own approach and defined the hedonic price function using three vectors for (1) the characteristics of the neighborhood, (2) location-specific environmental amenities and (3) structural characteristics of the house. With this improvement he tried to model and to describe spatial and location dependence in a better way.

After the integration of spatial and location aspects such as neighborhood effects in the hedonic price approach several analytical techniques have been suggested which deal with spatial effects in hedonic models. Bockstael (1996) followed Anselin’s (1988) and Griffith’s (1988) spatial perspective with a comparison of economic and ecological models. Griffith et al. (2003) improved this spatial perspective and developed a spatial auto-correlation approach that took dynamic and multidimensional impacts into consideration. Anselin (2003a, 2003b) modified his own former spatial approach model and created spatial regression models. All these spatial model specifications show spatial patterns as result of neighborhood interactions and spatial dynamics.

Based on Parsons (1990) first weighted hedonic regression approach, Cho et al. (2006) compared spatially weighted hedonic models and pointed out that the estimation of local values of individual amenities using locally weighted regression allowing for spatial non-stationary between local amenities.

In the face of all these hedonic model specifications, which are often single solutions for specific problems, and in contrary to former two-stage hedonic pricing approaches (Rosen, 1974, Freeman, 1974, Epple, 1987, Garrod et al., 1992a) we used a simple one-stage OLS regression technique integrating several control variables. This is done by regressing the marginal implicit price against a set of fiscal and socio-demographical variables in the hedonic pricing model. The integration of these control variables solves the problem of biased results due to the non-linearity of the hedonic pricing function.

Hedonic models of landscape benefits

Numerous hedonic pricing studies on the impact of natural amenities on property prices measured the values of landscape features such as woodland, trees, forest, grassland, wetland, agricultural land, pastureland and open space. For example, Anderson and Cordell (1988) associated scarcity of trees with price increase as well as increases in the tax base of a community. Garrod and Willis (1992a) emphasized the recreational benefits of woodland. Similarly, Tyrväinen (1997) showed non-wood benefits derived from pleasant landscape as well as recreational activities. Kim and Johnson (2002) expanded the model to include aesthetic and ecological factors, and Le Goffe's study (2000) integrated the non-market environmental goods of agricultural and forestry produce benefits. Le Goffe (2000) showed the negative impact on property prices due to agricultural and forestry externalities. Later, Bastian et al. (2002) estimated values of environmental amenities and agricultural land. The study showed that diverse and remote agricultural lands command higher prices than landscapes which are dominated by agricultural production. Further studies by Riddel (2001), Geoghegan (2002), Smith (2002), Irwin (2002), Marshall (2004), Walsh (2007) and Cho et al. (2008) dealt with the amenity variable "open space". They found that the scarcity of open space is directly linked with urbanization processes.

Furthermore, Smith et al. (1983), Costanza et al. (1989), Barbier (1993), Leggett et al. (2000), Mahan et al. (2000), Boyd et al. (2002) and Cho et al.. (2006) measured the value of water-related natural amenities using a hedonic pricing approach. The results showed that the quality of water-related natural amenities has an impact on recreational activities and the tourism sector.

In contrary to these former studies, we have used a broad set of different landscape, townscape and amenity variables[5] to measure the complex impact on property prices and to describe the willingness to pay for environmental goods.

Similar to Geoghegan (2002), we also included the aspect of community location impacts in our model. Our analysis purely investigated the value of residential real estate as a proxy for the local economy. The empirical model focuses on property price affected by amenity attributes of developed and natural landscape resources such as extensively managed cultural land or wilderness preserves. Similar to Halvorsen and Pollakowski (1981), we also considered the accessibility component to control for distance related amenity and agglomeration effects.

The specification of our hedonic pricing model includes a full set of available structural property variables. As Goodman (1989) described, the price structure of hedonic models is not stable when compared to property structures: estimates from market to market or year to year differ significantly. In empirical work, accumulating data from different time periods to obtain sufficient observations is often necessary. In order to solve this problem we have integrated a variable for the year of offer[6] in our model.

Our area-wide spatial unlimited hedonic pricing model examined how property characteristics, landscape and townscape management, historical heritage, natural amenities, accessibility characteristics, tourism infrastructure, fiscal conditions and socio-demographical characteristics affect residential property values. Furthermore, we used the

[5] See section Data
[6] The year in which the apartment was on the market.

same hedonic pricing model to examine possible urban-rural effects, as property and community characteristics may differ between urban and rural locations. For a more detailed analysis of the urban-rural effects we split the full dataset at the median of the variable for the distance to the next main center and at the median of the variable for the average altitude of a municipality. The analysis of these subsamples helps to understand location specific implicit prices based on different landscape endowment and landscape accessibility.

In order to compare the results of different hedonic pricing approaches it is important to know which market definition is used. We follow in line with the market definition of Hanley et al. (2001) for our models: „Market serves society by efficiently organizing economic activity. Markets use prices to communicate the requirements and limits of a diffuse and diverse society so as to bring about coordinated economic decisions in the most efficient manner." On the one hand the Swiss market is strongly influenced by its closeness to the European Union. On the other hand it shows all political and economic restriction of a self-sufficient country.

Data and sources

The study area contains about 956 municipalities situated all across Switzerland (see Figure 1). These municipalities were chosen on the basis of availability of property and environmental data during the investigation period. Property data was limited by the available property rental price. Environmental data was limited by the availability at a municipal level. Data from communities that had been politically restructured in the observation period could also not be used for the study.[7] Definitions and summary statistics of the variables used in our empirical analysis are provided in Table 1.

[7] Especially in western Switzerland many communities merged in the last 10 years.

Property data

Our main data source is a database of prices for apartments in the Swiss housing market. It is provided by the mortgage originator "Homegate". The data set records 80814 single-family home transactions between 2001 and 2007. It contains real estate prices provided by various contractors and information on several qualitative and quantitative property characteristics.

For our analysis we selected variables which directly characterize the observational objects. They include the monthly gross rent of the apartment (RENT), the living space of the apartment (LIVINGSPACE), the year of construction of the building (BUILTYEAR), the number of rooms (ROOMS), the floor (FLOOR) and the year of the offer (OFFERYEAR). Additionally, we used two dummy variables to indicate whether the building possesses a lift (LIFT) and a balcony (BALCONY).

The time component on the Swiss real estate market is an important factor for the analysis. Prices of vacant apartments are largely market-driven. They show current market values and conditions. In contrast apartments with ongoing tenancies tend to show the market value of a former period. Therefore, we only observed vacant apartments in our study.

Community data

Alongside the property variables, our analysis includes GIS-based municipality-level variables. They characterize location-specific amenities and other neighborhood features for 956 available municipalities represented in our property data sample. To carry out the analysis we combined the property-level and the municipality-level dataset. We differentiate five categories of municipality variables in our analysis: 1. Landscape and townscape management, 2. Natural Amenities, 3. Accessibility, 4. Tourism infrastructure and 5. Fiscal conditions and socio-demographic characteristics. Both the property variables and the community variables are summarized in Table 1.

The first category contains variables describing “landscape and townscape management” effects on the apartment price. Specifically, the dataset includes a variable for the percentage of undeveloped land among non-forested land in a municipality (OPENSPACE)[8], a variable for the percentage of high quality area near-natural land without vine in a municipality (NATURALLAND)[9], a variable for the percentage of industrial land use (INDUSTRY) and a variable for the percentage of land for recreational activities (RECREATION). All of these variables are derived from the Swiss land use statistics (FSO 1997). Additionally, a dummy variable HERITAGE indicates whether the municipality is listed in the national inventory of heritage townscapes (Federal Executive Council 2004). We use data from the Swiss Census 2000 of the Swiss Federal Statistical Office for POPDENSHIGH.

The second group contains “natural amenity” features that are unrelated to landscape management. Standard data processing stages in ArcGIS[10] were used to create these variables from the Swiss land use statistics (FSO 1997) and the vector datasets VECTOR25/ DEM25 of the Swiss Federal Office of Topography (SFOT 2004). These include a variable for the average altitude of a municipality (ALTITUDE), a variable for the percentage of south-facing settlement area (SOUTH) defined as south-east to south-west exposition and a variable for the percentage of area in a municipality covered by rivers (RIVER). We also use a variable for the percentage of settlement area with view to mountains with altitudes above 2000 Meters (MOUNTVIEW), a variable for the percentage of settlement area with view to a major lake (LAKEVIEW) and a variable for

[8] The definition is based on the categories 1 for forest and categories 11, 12, 13, and 15 for developed land (of the BN 15 data set with 15 land cover types).
[9] Including the categories 76, 17, 18, 15, 16, 95, 96, 12, 13, 14, 81, 88, 97, and 99 (BN 74 data set with 74 land cover types) - water shore vegetation, fens, orchards, hedgerows, non-closed forests, extensively farmed, unproductive grasslands, and many other natural or near-natural landscape elements
[10] ArcGIS is a standard GIS-software from the Environmental Systems Research Institute.

the distance to the next major lake from the center of a municipality (LAKEDISTANCE). These three variables, MOUNTVIEW, LAKEVIEW and LAKEDISTANCE, show the quality of settlement area regarding availability of high quality open source amenities. Climatic indicators are represented by a variable for the yearly hours of sunshine (SUNHOURS), which is interpolated from 69 Swiss meteorological stations (FOM 1990).

The third group can be classified as "accessibility" variables. Two variables (DISTMAINCENTER and DISTREGCENTER) measuring the shortest distance from a municipality center to the next main or regional center (IVT 2006) and a dummy variable (RAILWAY) indicating the presence of a railway station in a municipality (SFOT 2004) are used as proxies for accessibility.

Forth, we include two variables to describe "tourism infrastructure": HIKING indicates the length of walking and hiking paths in a municipality (SFOT 2004) and TOURISM represents the number of room nights per person in a municipality (FSO 2000).

Fifth, the "fiscal" variable TAXBURDEN measures the average income tax burden (federal, cantonal and communal tax) for a married childless person with an income of 60000 CHF (FTA 2006). Eventually, a "socio-demographic" variable indicating the percentage of foreigners in a municipality (FSO 2000), is included to account for otherwise unobservable variation of social heterogeneity and school quality.

Finally, we include dummy variables for the seven Swiss greater landscape regions "Geneva", "Central Plateau", "Northwest", "Zurich", "East", "Central" and "Ticino" (REGIONj) from the Swiss Federal Office for Territorial Development (SFTD 2006) to account for spatial variation that can not be explained by the model variables.

Empirical model

The usual procedure was to estimate the hedonic model with OLS. Hedonic models are reduced from statistical models. They describe the transaction prices as a function of the characteristics of the heterogeneous real estate. Because real estate is a complex good with many dimensions, differences in rental prices will be indicated by a number of factors. These include the quality of the housing structure on the property, neighborhood characteristics, the accessibility, and the environmental amenities associated with the property (Geoghegan 2002). With focus on these environmental amenities we use a functional form with a double-log specification as the best fit. Our empirical model is described by following equation:

$$
\begin{aligned}
\ln\mathrm{RENT} = {} & \\
& \alpha + \beta_1(\mathrm{LIVINGSPACE}) + \beta_2(\mathrm{BUILDYEAR}) + \beta_3(\mathrm{ROOMS}) \\
& + \beta_4(\mathrm{FLOOR}) + \beta_5(\mathrm{OFFERYEAR}) + \beta_6(\mathrm{LIFT*FLOOR}) + \beta_7(\mathrm{BALCONY}) \\
& + \beta_8(\mathrm{OPENSPACE}) + \beta_9(\mathrm{POPDENSHIGH*OPENSPACE}) \\
& + \beta_{10}(\mathrm{NATURALLAND}) + \beta_{11}(\mathrm{POPDENSHIGH*NATURALLAND}) \\
& + \beta_{12}(\mathrm{HERITAGE}) + \beta_{13}(\mathrm{INDUSTRY}) + \beta_{14}(\mathrm{RECREATION}) \\
& + \beta_{15}(\mathrm{ALTITUDE}) + \beta_{16}(\mathrm{SOUTH}) + \beta_{17}(\mathrm{SUNHOURS}) + \beta_{18}(\mathrm{MOUNTVIEW}) \\
& + \beta_{19}(\mathrm{LAKEVIEW}) + \beta_{20}(\mathrm{LAKEDISTANCE}) + \beta_{21}(\mathrm{RIVER}) \\
& + \beta_{22}(\mathrm{DISTMAINCENTER}) + \beta_{23}(\mathrm{DISTREGCENTER}) \\
& + \beta_{24}(\mathrm{RAILWAY}) + \beta_{25}(\mathrm{HIKING}) + \beta_{26}(\mathrm{TOURISM}) \\
& + \beta_{27}(\mathrm{TAXBURDEN}) + \beta_{28}(\mathrm{FOREIGNERS}) \\
& + \beta_{29}(\mathrm{REGION1}) + \beta_{30}(\mathrm{REGION2}) + \beta_{31}(\mathrm{REGION3}) + \beta_{32}(\mathrm{REGION4}) \\
& + \beta_{33}(\mathrm{REGION5}) + \beta_{34}(\mathrm{REGION6}) + \beta_{35}(\mathrm{REGION7}) + \varepsilon
\end{aligned}
$$

This functional form uses the natural logarithm of continuous and unlimited variables in the estimation and allows an easy interpretation of the estimated coefficients. The coefficients of the continuous variables are elasticities. The percentage change in the dependent variable leads to a one-percent change in an explanatory variable.

To account for the fact that observations within communities are not independent, we also present error probabilities calculated from an ANOVA table in which the effects (mean squares) of the variables are tested against the (residual) variation among communities.

Results

Double-log hedonic model (full dataset)

Descriptive statistics for the explanatory variables are presented in Table 1. The estimated hedonic price equation is shown in Table 2. The second, third and fourth columns contain the standard regression results: estimated coefficients, t-statistics and P-value. Column five presents the corrected P-values from the ANOVA (see section above). Figure 2 shows selected t-values of the hedonic price equation.

Including regional dummies, the estimated hedonic regression model explains 82.4 percent of the variation in apartment rental prices. All coefficient estimates on the property variables show the expected signs and are highly significant. While apartments on a higher level (FLOOR) tend to be cheaper than others, the interaction LIFT*FLOOR is positive.

The landscape and townscape management variables INDUSTRY and RECREATION have the expected sign and are highly significant. Apartment rental prices increase with increasing proportions of land devoted to recreational opportunities and they decrease with increasing proportions of land in industrial use. The variable HERITAGE also has the anticipated positive sign and is significant at the five percent level. However, we found no evidence of significant effects for OPENSPACE and NATURALLAND. In order to examine whether population density affects the estimates of open space and near-natural land we also include the interactions of OPENSPACE and NATURALLAND with a dummy variable POPDENSHIGH[11]. The positive effect of the OPENSPACE interaction and the negative effect of the NATURALLAND interaction indicate that both open space and near-natural land are more highly valued in the more densely populated municipalities.

The natural amenity variables are significant at the 0.1 percent level, except the variable RIVER, which is only significant in the ANOVA. All these variables have the expected sign, except the variable for mountain view. Overall, the estimates for the natural amenity variables tend to reveal a positive and significant willingness-to-pay for landscape-related amenity attributes.

The coefficients on the accessibility variables DISTMAINCENTER and DISTREGCENTER suggest the expected positive relationship between proximity to those centers and apartment rental prices (although the statistically significant level of traffic accessibility to regional center is not confirmed in the ANOVA). Moreover, a positive effect can be observed for the accessibility variable RAILWAY which indicates the presence of a railway station.

The number of room nights (TOURISM) is positive and highly significant. The unexpected negative sign of the variable for the hiking trail density (HIKING) suggests possible correlation interactions with an unobserved variable that decreases prices and is not fully captured in the model.[12] With the lower significance level in the ANOVA and the low coefficient we can show the marginal impact from the tourism infrastructure on the apartment rental price.

The socio-demographic variable FOREIGNERS is significant at the 0.01 percent level and has the expected negative sign. The estimate for TAXBURDEN suggests that the income tax burden tends to be capitalized in property prices to a large extent. A one percent increase in income tax burden is associated with a 0.328 percent decrease in apartment rental price.

[11] POPDENSHIGH = 1 if municipality has an above-median population density, = 0 else.
[12] The remoteness effect explains urban-rural advantages vs. disadvantages.

Furthermore, the dummy variables for the seven Swiss greater regions account for substantial regional differences in apartment rental prices caused by factors not included in our model.

Finally, with our results we can show that most of the p-values of the ANOVA confirm and support the significance's of the basic regression model, except those of the variables OPENSPACE, NATURALLAND, MOUNTVIEW, RIVER and DISTREGCENTER. In these cases, the OLS model, which assumes independent observations, apparently overestimates the significance of the community variables.

Central versus peripheral locations

Given the significant interactions of OPENSPACE and NATURALLAND with population density in the full sample model, it is interesting to examine how the estimates differ between central and peripheral locations. We split the sample at the median of the variable for distance to the next main center (DISTMAINCENTER). The results are reported in Table 3. We use the same explanatory variables as described in the basis model, excluding the interaction variables, with an adjusted R-squared of 0.797 for the sub sample of the central locations and 0.847 for the sub sample of the peripheral locations.

In comparison to the full sample, six of the seven property variables show highly significant estimates with identical signs. However, the variable OFFERYEAR strongly differs in the significance level and shows no significance in the central location subsample.

Comparing the two subsamples, the effects of the variables INDUSTRY and RECREATION on property prices are similar. However, the effects of OPENSPACE, NATURALLAND and HERITAGE differ between the subsamples. Open space and heritage are significantly positive in the central communities, but all three variables have a negative sign in the peripheral locations. The natural amenity variables have similar coefficients and significances in both subsamples, except the variable for the southern exposition of the settlement area. SOUTH has a positive sign and is statistically significant at the 0.01 level in the subsample for central locations, but has no impact on the apartment rental price in the peripheral locations.

The closeness to a main center has a positive effect on the apartment rental price in peripheral locations. The unexpected positive effect of distance to the next regional center and the negative effect of the railway station show a possible overestimation of unobserved aspects. The differences of the accessibility variables between the subsamples show the distance effect on the property price clearly. Finally, TAXBURDEN remains highly significant and has a negative sign in both subsamples. The percentage of foreigners has a small negative impact on property prices in peripheral locations, while no significant relation was found in the central communities.

Lowlands versus mountains

It is also interesting to examine how the results differ between locations with low and high altitude. Thus, we split the full sample at the median of the altitude variable (ALTITUDE). The results are shown in Table 4. Each subsample model explains more than 80 percent of the variation in apartment rental prices, with an adjusted R-squared of 0.822 for the low altitude sample and 0.840 for the high altitude sample.

The estimates for the property variables are similar to those in the full sample. The coefficients of the variables have the intuitive sign and are highly significant in both models. The effects of landscape and townscape management on apartment rental prices differ between low- and high-altitude municipalities. The coefficients on NATURALLAND and HERITAGE show reverse signs for each variable in both subsamples. The negative effect of INDUSTRY on the apartment rental price is clearly shown in the lowlands subsample. RECREATION is positive and significant in both subsamples.

Furthermore, the effects of SUNHOURS and SOUTH on property prices differ between the subsamples. The sunshine duration is more relevant in the high elevation subsample and the southern exposition acts as significant price-driver in both altitude splitting subsamples. LAKEDISTANCE is negative and highly significant in the high altitude sample only. In contrast to that, the distance to the next major lake has no significant price impact in lowland locations. RIVER has a positive effect in the low altitude sample and a negative sign in the mountains subsample.

The accessibility and tourism infrastructure variables are highly significant at the 0.01 percent level in the high altitude subsample. Four of these five variables are not significant in the lowlands subsample. Railway stations and the distance to the next regional center as well as the distance to the next main center have a strong impact on the rental price at a high elevation. A well developed tourism infrastructure also has a strongly positive influence on the property price among the higher altitude locations. The fiscal and the socio-demographical variables show the expected signs and statistical significances. In summary landscape and townscape management has different effects on apartment rental prices depending on altitude of the community.

The following conclusions can be drawn from the five estimated models: firstly, the property characteristics effects on property prices differ only marginally among the models. Secondly, the explanatory community variables are complexly connected. For instance, distance and altitude effects are strongly connected with the landscape endowment. Thirdly, the differences between the models tend to be stronger for the landscape and townscape management variables than for the natural amenity and accessibility variables. Finally, the combinations of different types of explanatory community variables, such as landscape and townscape management, natural amenities, accessibility, tourism infrastructure, fiscal conditions and socio-demographic characteristics, catch the explanations for the effects of landscape and townscape resources on the property price.

Discussion

Our results show that landscape and townscape management has a strong impact on property prices. Therefore, we focus on the variables OPENSPACE, NATURALLAND, INDUSTRY and RECREATION in our discussion. Furthermore, we discuss the time-variants of environmental goods and the definition of the market in hedonic pricing approaches.

Twenty years after Roback (1982) embedded the elements "Amenity" and "Disamenity" as factors into the hedonic price approach, Riddel (2001), Geoghegan (2002), Smith (2002), Irwin (2002), Marshall (2004), Walsh (2007) and Cho et al. (2008) published a variety of studies which integrated the new amenity variable "open space" into their models to explain the scarcity of landscape resources caused by the urbanization process. In addition to "open space" we integrated a variable for "near-natural land" into our study. For the first time in environmental economic literature our approach combines different variables for high quality landscape into one hedonic model. Our results show that only open space has a positive impact on property rental prices in urban communities. It highlights the population's sensitivity to possible changes in the accessibility and availability of this high quality landscape resource. In contrast, the unexpected negative effect of near-natural land in the main model interaction shows a possible different perception and overestimation of this specific quality variable. A further technical aspect to explain the above phenomenon is that the five biggest cities are excluded from the dataset. Therefore, the scarcity of this special natural good is probably not recognized enough.

During the analysis we were confronted with some unexpected results. Our findings show there is no higher benefit from high quality natural amenities in rural areas, because they are freely available. The available land is larger and the building density is lower in peripheral communities. The distance dataset splitting as well as the altitude dataset splitting expand the discussion on high quality natural amenities. Effects of natural amenities and open space differ between lowland and mountainous communities as well as between rural and urban areas. This is consistent with findings by Walsh (2007).

In line with previous research our results suggest that the demand for recreational opportunities and industrial land use is the driving force for the development of landscape resources. For instance, More et al. (1988) emphasized the positive effects of urban parks on the facility for recreation, whilst Tyrväinen (1997) also showed that the urban forest provides many positive external effects such as recreational opportunities. Furthermore, Leggett and Bockstael (2000) estimated the positive benefits of improving water quality in urban areas. Smith et al. (1995), Palmquist et al. (1997) and Nelson (2004) presented evidence depicting the effect of negative localized externalities in industry areas, such as noise emission, air pollution and olfactory immersion. The pressure on developable land increases the competition between urban and rural areas. The results of our model specification, using interactions of population density and open space provide the evidence for this urban-rural competition.

In contrast to earlier studies, we used distance to main city center instead of population density for identifying urban and rural differences. The reason for that is based on the specific settlement pattern in Switzerland. Rural communities can also have a high population density because of their limited settlement area. And a good infrastructure and accessibility makes a rural community to an attractive location. Hence, we are convinced that the variable for distance to the next center can cover the urban-rural differentiation in Switzerland better than population density could ever reproduce.

Freeman (1993) had already proposed that in the case of amenities, the weakness in hedonic property modeling is that most environmental goods are time-variant and may lead to different price estimates. Furthermore, Riddel (2001) suggested that caution is necessary whilst using open space as an independent variable in hedonic models as it may be time trended. Since open space is a potential variable for property prices, this issue must be carefully examined. To limit the time dynamic problem of environmental goods in hedonic models, we have used a full set of different non-correlated landscape and natural amenity variables such as MOUNTVIEW and LAKEVIEW or ALTITUDE and SOUTH, as well as the variable BUILTYEAR to control a possible price variation during the observation period. Our results do not confirm that environmental goods are time-variant.

Finally, the definition of the market is important for the hedonic pricing approach. When we follow Hanley's assumptions (Hanley et al. 2001) for a market of environmental resources we have to consider that this market can also fail. For instance in Switzerland, the closeness to the European Union and the economic relationship with neighbor countries leads to the conclusion there is a lively exchange in the property market. Switzerland seems to be a closed market for middle income households due to political and administrative restrictions. There practically only is international access to the Swiss property market in the high price segment.

Conclusions

Landscape resources provide a variety of positive externalities. They are important for the local economy and environmental benefits. With a dataset covering all cantons we can present the first nation-wide model in the research field of Hedonic Pricing and local landscape resources. Our approach combines property and community data, and is based on a large dataset at a municipal level in Switzerland. The results of our project are interesting for policy makers, since they help to promote environmental benefits of non-market landscape resources on the property market in Switzerland.

We have analyzed the benefits of landscape resources on property prices based on a nation-wide hedonic pricing model. It includes property characteristics, landscape and townscape management, historical heritage, natural amenities, accessibility characteristics and tourism infrastructure, as well as fiscal conditions and socio-demographical characteristics.

Our results show that several aspects of landscape and townscape management as well as natural amenities have a strong impact on property prices. In particular, landscape endowment and local accessibility are significant determinants of local attractiveness. We can confirm the well known differences between urban and rural locations in regard to landscape resources. Landscape-related location factors at a community level are becoming increasingly important. The results of the submodels support the idea that settlement pressure tends to increase the wish for and the care of natural amenities. This means that higher apartment rental prices in urban municipalities heighten the population's sensitivity to possible changes in the accessibility and availability of landscape resources.

Several aspects of these results help to identify possible areas for future research. Firstly, to explain the rural-urban effect on property prices with focus on landscape resources in other countries. Secondly, to prove that property prices decrease with loss of open space and historical heritage, and that natural amenities such as southern exposition and lake view have a positive effect on apartment rental prices, especially in municipalities which are not directly located on a major lake. Thirdly, to aim for a better understanding of landscape and townscape management effects. For instance the different impact of historical heritage on property prices in urban and rural communities requires different political and planning decisions.

References

Anderson, L.M., Cordell, H.K., 1988. Influence of trees on residential property values in Athens, Georgia (USA): A survey based on actual sales prices. Landscape and Urban Planning 15(1-2):153-164.

Anselin, L., 1988. Spatial econometrics: Methods and models. Kluwer Acadamic Publishers, Dordrecht, The Netherlands.

Anselin, L., 2003a. Under the hood: Issues in the specification and interpretation of spatial regression models. Agricultural Economics 27(3):247-267.

Anselin, L., 2003b. Spatial externalities, spatial multipliers, and spatial econometrics. International Regional Science Review 26(2):153-166.

Atkinson, S.E., Crocker T.D., 1987. A Bayesian approach to assessing the robustness of hedonic property value studies. Journal of Applied Econometrics 2(1):27-45.

Barbier, E.B, 1993. Sustainable use of wetlands valuing tropical wetland benefits: Economic methodologies and applications. The Geographical Journal 159(1):22-32.

Bartik, T.J., 1987. The estimation of demand parameters in hedonic price models. Journal of Political Economy 95(1):81-88.

Bastian, C.T., McLeod, D.M., Germino, M.J., Reiners, W.A., Blasko, B.J., 2002. Environmental amenities and agricultural land values: a hedonic model using geographic information systems data. Ecological Economics 40(3):337-349.

Bockstael, N.E., 1996. Modeling economics and ecology: The importance of a spatial perspective. American Journal of Agricultural Economics 78(5):1168-1180.

Boyd, J., Wainger, L., 2002. The economics of wetland ecosystem restoration and mitigation: Landscape indicators of ecosystem service benefits. American Journal of Agricultural Economics 84(5):1371-1378.

Brawn, J.N., Rosen, H.S., 1982. On the estimation of structural hedonic price models. Econometrica 50(3):765-768.

Burel, F., Baudry, J., 1995. Social, aesthetic and ecological aspects of hedgerows in rural landscapes as a framework for greenways. Landscape and Urban Planning 33(1-3):327-340.

Can, A., 1992. Specification and estimation of hedonic housing price models. Regional Science and Urban Economics 22(3):453-474.

Cheshire, P., Sheppard, S, 1995. On the price of land and the value of amenities. Economica 62(2):247-67.

Cho, S.-H., Bowker, J.M., Park, W.M., 2006. Measuring the contribution of water and green space amenities to housing values: An application and comparison of spatially-weighted hedonic models. Journal of Agricultural and Resource Economics 31(3):485-507.

Cho, S.-H., Poudyal, N.C., Roberts, R.K., 2008. Spatial analysis of the amenity value of green open space. Ecological Economics 66(2-3):403-416.

Costanza, R., Farber, S.C., Maxwell, J., 1989. Valuation and management of wetland ecosystems. Ecological Economics 1(4):335-361.

Cropper, M.L., Deck, L.B., McConnell, K. E., 1988. On the choice of functional form for hedonic price functions. The Review of Economics and Statistics 70(4):668-675.

Epple, D., 1987. Hedonic prices and implicit markets: Estimating demand and supply functions for differentiated products. The Journal of Political Economy 95(1):59-80.

Fabos, J.G., 1995. Introduction and overview: the greenway movement, uses and potentials of greenways. Landscape and urban planning 33(1-3):1-13.

Federal Executive Council 2004. Regulation on the national inventory of heritage townscapes (VISOS). Federal Printing Office, Bern, Switzerland.

FOM, 1990. Absolute sunshine hours 1961-1990. Federal Office of Meteorology and Climatology MeteoSwiss, Bern, Switzerland.

Freeman III, A.M., 1974. On estimating air pollution control benefits from land value studies. Journal of Environmental Economics and Management 1(1):74-83.

Freeman III, A.M., 1979. Hedonic prices, property values and measuring environmental benefits: A survey of the issues. Scandinavian Journal of Economics 81(2):154-173.

Freeman III, A.M., 1993. The measurement of environmental and resource values. RFF Press, Washington, USA.

FSO, 1997. Land use statistics 1992/1997. GEOSTAT. Federal Office of Statistics, Neuenburg, Switzerland.

FSO, 2000. Federal census of population 2000. GEOSTAT. Federal Office of Statistics, Neuenburg, Switzerland.

FTA, 2006. Direkte Bundessteuer, Steuerperiode 2005/2006, Natürliche Personen. Federal Tax Administration, Bern, Switzerland.

Garrod, G., Willis, K., 1992a. The environmental economic impact of woodland: a two-stage hedonic price model of the amenity value of forestry in Britain. Applied Economics 24( ):715-728.

Garrod, G., Willis, K., 1992b. The amenity value of woodland in Great Britain: A comparison of economic estimates. Environmental and Resource Economics 2(4):415-434.

Geoghegan, J., Wainger, L.A., Bockstael, N.E., 1997. Spatial landscape indices in a hedonic framework: An ecological economics analysis using GIS. Ecological Economics 23(3):251-264.

Geoghegan, J. 2002. The value of open spaces in residential land use. Land Use Policy 19(1):91-98.

Goodman, A.C., 1989. Topics in empirical urban housing research. In: The economics of housing markets, R.F. Muth and A.C. Goodman (Eds.). Harwood Academic, Chur, Switzerland.

Graves, P., Murdoch, J.C., Thayer, M.A., Waldman, D., 1988. The robustness of hedonic price estimation: Urban air quality. Land Economics 64(3):220-233.

Griffith, D.A., 1988. Estimating spatial autoregressive model parameters with commercial statistical packages. Geographical Analysis 20(2):176-186.

Griffith, D.A., Wong, D.W.S., Whitfield, T., 2003. Exploring relationships between the global and regional measures of spatial autocorrelation. Journal of Regional Science 43(4):683-710.

Halvorsen, R., Pollakowski, H., 1981. Choice of functional form for hedonic price equations. Journal of Urban Economics 10(2):37-49.

Hanley, N., Shogren, J.F., White, B., 2001. Introduction to environmental economics. Oxford University Press, Oxford, United Kingdom.

Irwin, E.G., 2002. The effects of open space on residential property values. Land Economics 78(4):465-480.

IVT, 2006. ETH travel data archive. Accessibility by road travel and public transport. ETH Zurich.

Kim, Y., Johnson, R.L., 2002. The impact of forests and forest management on neighboring property values. Society and Natural Resources 15(10):887-901.

Le Goffe, P., 2000. Hedonic pricing of agriculture and forestry externalities. Environmental and Resource Economics 15(4):397-401.

Leggett, C.G., Bockstael, N.E., 2000. Evidence of the effects of water quality on residential land prices. Journal of Environmental Economics and Management 39(2):121-144.

Mahan, B.L., Polasky, S., Adams, R., 2000. Valuing urban wetlands: a property price approach. Land Economics 76(1):100-113.

Marshall, E., 2004. Open space amenities, interacting agents, and equilibrium landscape structure. Land Economics 80(2):272-293.

Medley, K.E., Pobocik, C.M., Okey, B.W., 2003. Historical changes in forest cover and land ownership in a midwestern U.S. landscape. Annals of the Association of American Geographers 93(1):104-120.

More, T.A., Stevens, T., Allen, P.G., 1988. Valuation of urban parks. Landscape and Urban Planning 15(1-2):139-152.

Nelson, J.P., 1978. Residential choice, hedonic prices, and the demand for urban air quality. Journal Urban Economic 5(3):357-69.

Nelson, J.P., 2004. Meta-analysis of airport noise and hedonic property values: Problems and prospects. Journal of Transport Economics and Policy 38(1):1-28.

Ndubisi, F., De Meo, T. Ditto, N.D., 1995. Environmentally sensitive areas: a template for developing greenway corridors. Landscape and Urban Planning 33(1-3):159-177.

Palmquist, R.B., 1983. Estimating the demand for air quality from property value studies. North Carolina State University, Raleigh, USA.

Palmquist, R.B., Roka, F.M., Vukina, T., 1997. Hog operations, environmental effects, and residential property values. Land Economics 73(1):114-124.

Parsons, G.R., 1990. Hedonic prices and public goods: An argument for weighting locational attributes in hedonic regressions by lot size. Journal of Urban Economics 27(3):308-321.

Riddel, M., 2001. A dynamic approach to estimating hedonic prices for environmental goods: An application to open space purchase. Land Economics 77(4):494-512.

Roback, J., 1982. Wages, rents, and the quality of life. Journal of Political Economy 90(6):1257-1277.

Rosen, S., 1974. Hedonic prices and implicit markets: Product differentiation in pure competition. Journal of Political Economy 82(1):34-55.

SFOT, 2004. Landscape-model VECTOR25 and elevation-model DEM25. Swiss Federal Office of Topography, Wabern, Switzerland.

SFTD, 2006. Spatial classification - Swiss greater regions. Swiss Federal Office for Territorial Development, Bern, Switzerland.

Smith, V.K., Desvousges, W.H., McGivney, M.P., 1983. Estimating water quality benefits: An econometric analysis. Southern Economic Journal 50(2):422-437.

Smith, V.K., Huang, J.-C., 1995. Can markets value air quality? A meta-analysis of hedonic property value models. Journal of Political Economy 103(1):209-227.

Smith, V.K., Poulos, C., Kim, H., 2002. Treating open space as an urban amenity. Resource and Energy Economics 24(1):107-129.

Tietenberg, T., 2006. Environmental and natural resource economics. Addison-Wesley, New York, USA.

Tyrväinen, L., 1997. The amenity value of the urban forest: an application of the hedonic pricing method. Landscape and Urban Planning 37(3):211-222.

Tyrväinen, L., Miettinen, A., 2000. Property prices and urban forest amenities. Journal of Environmental Economics and Management 39(2):205-223.

Tyrväinen, L., Mäkinen, K., Schipperijn, J., 2007. Tools for mapping social values of urban woodlands and other green areas. Landscape and Urban Planning 79(1):5-19.

Walsh, R., 2007. Endogenous open space amenities in a locational equilibrium. Journal of Urban Economics 61(2):319-344.

Figure 1: Municipalities represented in the dataset

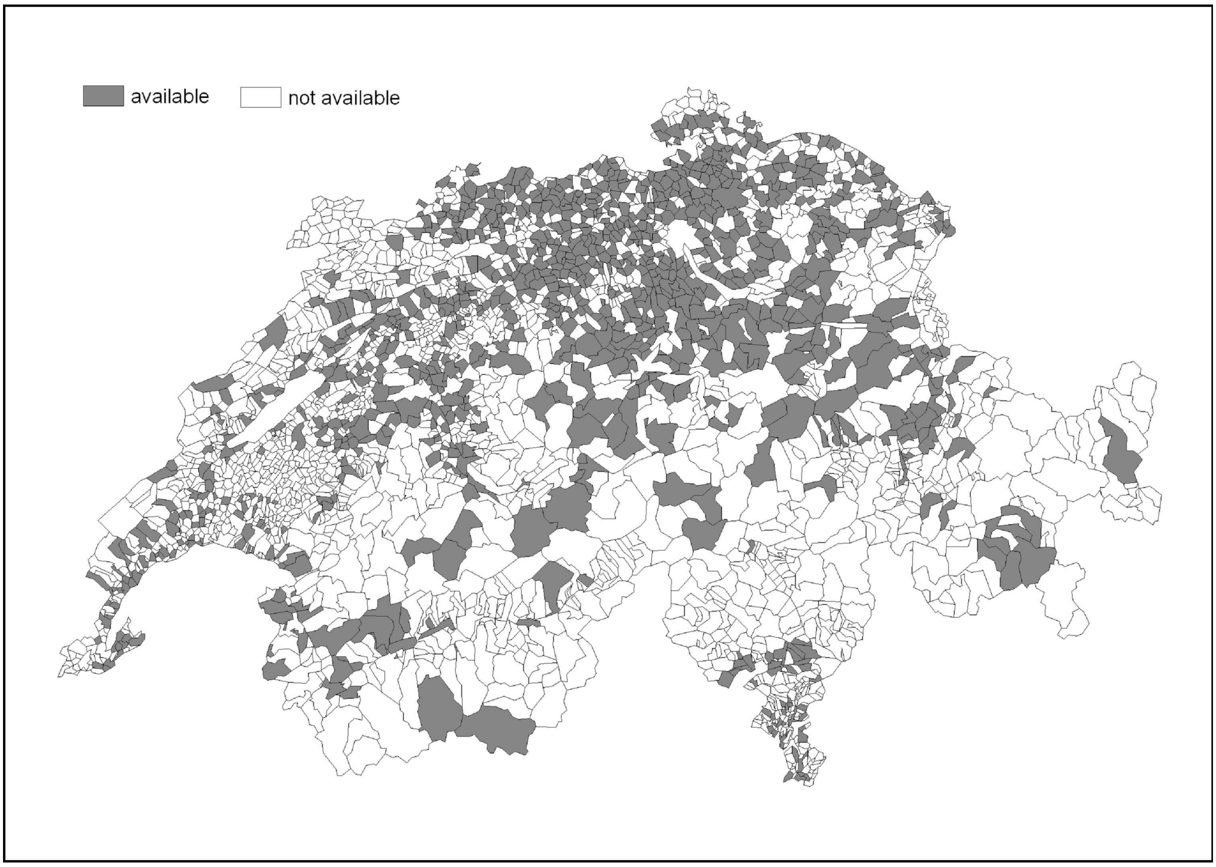


Figure 2: Selected t-values – Double-log hedonic model (full dataset)

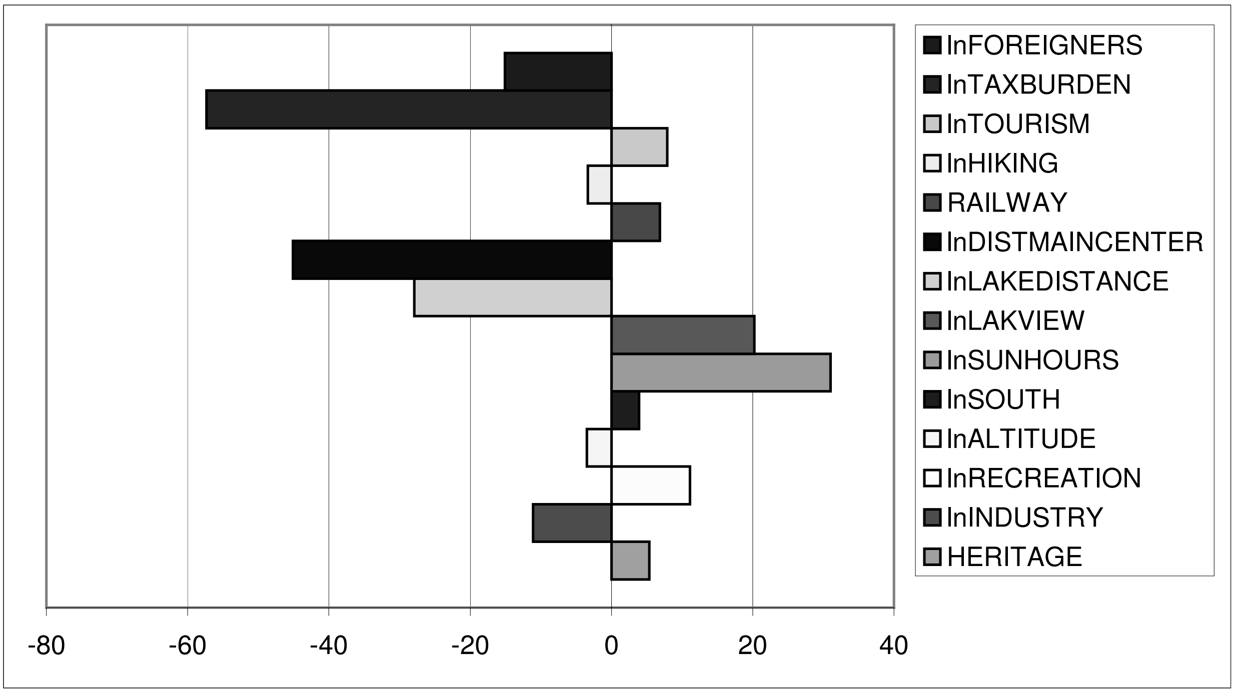


Table 1: Definition of variables and summary statistics

Variable name	Description	Mean	SD	Min	Max
Property characteristics					
RENT	monthly gross net-rent of the apartment (in CHF)	1600	708.678	305	9800
LIVINGSPACE	living space of the apartment (in m2)	85.03	33.071	13	370
BUILTYEAR	year of construction	1976	32.908	1500	2007
ROOMS	number of rooms	3.509	1.177	1	10
FLOOR	floor of apartment	1.842	1.611	0	8
OFFERYEAR	year of offer	2005	1.506	2001	2007
LIFT	dummy variable indicating whether the building has a lift (0=no, 1=yes)	0.352	0.478	0	1
BALCONY	dummy variable indicating whether the dwelling has a balcony (0=no, 1=yes)	0.571	0.495	0	1
Community characteristics					
Landscape and townscape management					
OPENSPACE	percentage of undeveloped land among non-forested land in a municipality	0.580	0.119	0.100	0.980
NATURALLAND	percentage of high quality near-natural land in a municipality	0.044	0.023	0.003	0.24
HERITAGE	dummy variable indicating whether a municipality is listed in the national inventory of heritage townscapes (0=no, 1=yes)	0.456	0.498	0	1
INDUSTRY	percentage of industrial land use in a municipality	0.025	0.021	0	0.160
RECREATION	percentage of land for recreational activities in a municipality	0.020	0.018	0	0.12
POPDENSHIGH	dummy variable indicating whether a municipality has a high or low population density (0=no for lower than median, 1=yes for higher than median)	0.255	0.435	0	1
Natural amenities					
ALTITUDE	average altitude of a municipality (in m)	535.1	153.017	280.2	3049.8
SOUTH	percentage of settlement area with southern exposition	0.471	0.282	0	1
SUNHOURS	hours of sunshine per year in a municipality	1519	132.194	1265	2180
MOUNTVIEW	percentage of settlement area with mountain view (restricted of a distance between 1km and 100km)	0.555	0.322	0	1
LAKEVIEW	percentage of settlement area with view to a major lake (Restriction of major lake: surface >100 hectares)	0.182	0.326	0	1
LAKEDISTANCE	average distance to major lake from the centre of a municipality in km (Restriction of major lake: surface >100 hectares)	12.428	12.434	0.02	51.77
RIVER	percentage of river area in a municipality	0.009	0.014	0	0.105
Accessibility					
DISTMAINCENTER	distance from the municipality center to next main center (in km) - Zurich, Geneva, Basel, Bern and Lausanne	31.952	34.249	1.396	218.725
DISTREGCENTER	distance from the municipality center to next regional center (in km)	6.696	6.359	0	60.16
RAILWAY	dummy variable indicating whether there is a railway station in a municipality (0=no, 1=yes)	0.737	0.44	0	1

Table 1 (continued)

	Description	Mean	SD	Min	Max
Tourism infrastructure					
HIKING	length of walking and hiking paths in a municipality (m per ha)	18.712	7.525	0.86	55.741
TOURISM	number of overnight stays in a municipality per capita	2.753	8.218	0	209.998
Fiscal conditions					
TAXBURDEN	average tax burden (income tax) of a person with an income of 60000 CHF in a municipality (in percent)	8.375	1.695	4.37	13.13
Socio-demographical characteristics					
FOREIGNERS	percentage of foreigners in a municipality	0.212	0.081	0.004	0.46
Regional dummies					
REGIONj (j=1..7)	dummy variables indicating whether a municipality is within a Swiss greater landscape region of “Geneva”, “Central Plateau”, “Northwest”, “Zurich”, “East”, “Central” and “Ticino” (0=no, 1=yes)	-	-	0	1

Table 2: Double-log hedonic model (full dataset)

Variable group	Variable name	Estimate	t-value	P-value		P-anova[13]	
	(Intercept)	-86.090	-13.586	0.000	***		
Property characteristics	lnLIVINGSPACE	0.639	207.822	0.000	***	0.000	***
	lnBUILTYEAR	1.342	36.605	0.000	***	0.000	***
	lnROOMS	0.166	54.002	0.000	***	0.000	***
	lnFLOOR	-0.018	-14.029	0.000	***	0.000	***
	lnOFFERYEAR	10.310	12.386	0.000	***	0.000	***
	LIFT*lnFLOOR	0.041	32.538	0.000	***	0.000	***
	BALCONY	0.020	14.109	0.000	***	0.000	***
Landscape and townscape management	lnOPENSPACE	-0.053	-8.538	0.000	***	0.631	
	POPDENSHIGH*lnOPENSPACE	0.051	4.030	0.000	***	0.013	**
	lnNATURALLAND	0.042	1.731	0.083	*	0.695	
	POPDENSHIGH*lnNATURALLAND	-0.039	-10.866	0.000	***	0.000	***
	HERITAGE	0.009	5.373	0.000	***	0.000	***
	lnINDUSTRY	-0.302	-11.079	0.000	***	0.000	***
	lnRECREATION	0.413	11.108	0.000	***	0.000	***
Natural amenities	lnALTITUDE	-0.015	-3.492	0.001	***	0.000	***
	lnSOUTH	0.007	3.892	0.000	***	0.000	***
	lnSUNHOURS	0.457	31.030	0.000	***	0.003	***
	lnMOUNTVIEW	-0.003	-1.688	0.091	*	0.000	***
	lnLAKVIEW	0.044	20.238	0.000	***	0.000	***
	lnLAKEDISTANCE	-0.028	-27.927	0.000	***	0.000	***
	lnRIVER	0.010	0.248	0.804		0.000	***
Accessibility	lnDISTMAINCENTER	-0.055	-45.086	0.000	***	0.000	***
	lnDISTREGCENTER	-0.002	-6.883	0.000	***	0.084	*
	RAILWAY	0.012	6.856	0.000	***	0.009	***
Tourism infrastructure	lnHIKING	-0.006	-3.331	0.001	***	0.002	***
	lnTOURISM	0.008	7.898	0.000	***	0.000	***
Fiscal conditions	lnTAXBURDEN	-0.328	-57.322	0.000	***	0.000	***
Socio-demogr. characteristics	lnFOREIGNERS	-0.126	-15.087	0.000	***	0.000	***
Regional dummies	REGIONj	yes					
Adjusted R-squared:		0.8243					
Number of observations:		80814					

Notes: Significance levels: *** = significant at p < 0.01, ** = significant at p < 0.05, * = significant at p < 0.1

[13] Corrected P-value from ANOVA

Table 3: Double-log hedonic model for central and peripheral subsamples (median split based on distance to main center)

		Central locations				Peripheral locations			
Variable group	Variable name	Estimate		P-anova[14]		Estimate		P-anova[15]	
	(Intercept)	-14.299				-159.3	***		
Property characteristics	lnLIVINGSPACE	0.583	***	0.000	***	0.702	***	0.000	***
	lnBUILTYEAR	2.009	***	0.000	***	1.046	***	0.000	***
	lnROOMS	0.218	***	0.000	***	0.098	***	0.002	**
	lnFLOOR	-0.022	***	0.000	***	-0.010	***	0.000	***
	lnOFFERYEAR	0.351		0.127		20.21	***	0.000	***
	LIFT*lnFLOOR	0.038	***	0.000	***	0.036	***	0.000	***
	BALCONY	0.021	***	0.000	***	0.019	***	0.000	***
Landscape and townscape management	lnOPENSPACE	0.028	*	0.000	***	-0.085	***	0.002	**
	lnNATURALLAND	-0.024		0.002	**	-0.100	***	0.000	***
	HERITAGE	0.019	***	0.000	***	-0.025	***	0.002	**
	lnINDUSTRY	-0.213	***	0.000	***	-0.290	***	0.000	***
	lnRECREATION	0.092	*	0.000	***	1.091	***	0.000	***
Natural amenities	lnALTITUDE	-0.060	***	0.114		-0.007		0.000	***
	lnSOUTH	0.023	***	0.000	***	-0.003		0.000	***
	lnSUNHOURS	0.320	***	0.017	**	0.629	***	0.893	
	lnMOUNTVIEW	-0.013	*	0.000	***	-0.009	***	0.000	***
	lnLAKVIEW	0.094	***	0.000	***	0.008	**	0.000	***
	lnLAKEDISTANCE	-0.010	***	0.000	***	-0.023	***	0.000	***
	lnRIVER	-0.529	***	0.000	***	-0.022		0.271	
Accessibility	lnDISTMAINCENTER	-0.047	***	0.000	***	-0.143	***	0.000	***
	lnDISTREGCENTER	-0.002	***	0.178		0.003	***	0.001	**
	RAILWAY	0.021	***	0.532		-0.009	***	0.013	**
Tourism infrastructure	lnHIKING	0.007	.	0.511		-0.019	***	0.998	
	lnTOURISM	-0.022	***	0.169		0.058	***	0.000	***
Fiscal conditions	lnTAXBURDEN	-0.502	***	0.000	***	-0.345	***	0.000	***
Socio-demogr. characteristics	lnFOREIGNERS	-0.004		0.835		-0.030	**	0.003	**
Regional dummies	REGIONj	Yes				Yes			
Adjusted R-squared:		0.7969				0.8466			
Number of observations:		40407				40407			

Notes: see Table 2.

[14] Corrected P-value from ANOVA
[15] Corrected P-value from ANOVA

Table 4: Double-log hedonic model for lowlands and mountains subsamples (median split based on altitude)

Variable group	Variable name	Lowlands Estimate		P-anova[16]		Mountains Estimate		P-anova[17]	
	(Intercept)	-102.400	***			-56.610	***		
Property characteristics	lnLIVINGSPACE	0.616	***	0.000	***	0.662	***	0.000	***
	lnBUILTYEAR	1.779	***	0.000	***	1.050	***	0.000	***
	lnROOMS	0.184	***	0.000	***	0.142	***	0.000	***
	lnFLOOR	-0.026	***	0.000	***	-0.009	***	0.000	***
	lnOFFERYEAR	12.120	***	0.000	***	6.628	***	0.000	***
	LIFT*lnFLOOR	0.040	***	0.000	***	0.042	***	0.000	***
	BALCONY	0.018	***	0.000	***	0.020	***	0.000	***
Landscape and townscape management	lnOPENSPACE	-0.024	**	0.286		0.011		0.279	
	lnNATURALLAND	-0.124	***	0.000	***	0.200	***	0.000	***
	HERITAGE	0.039	***	0.000	***	-0.013	***	0.000	***
	lnINDUSTRY	-0.212	***	0.000	***	-0.060		0.000	***
	lnRECREATION	0.332	***	0.000	***	0.834	***	0.000	***
Natural amenities	lnALTITUDE	0.185	***	0.450		-0.067	***	0.000	***
	lnSOUTH	0.015	***	0.000	***	0.037	***	0.049	**
	lnSUNHOURS	0.215	***	0.943		0.625	***	0.004	**
	lnMOUNTVIEW	-0.012	***	0.000	***	-0.024	***	0.000	***
	lnLAKVIEW	0.111	***	0.000	***	0.041	***	0.000	***
	lnLAKEDISTANCE	0.002		0.110		-0.034	***	0.000	***
	lnRIVER	0.430	***	0.000	***	-0.842	***	0.015	**
Accessibility	lnDISTMAINCENTER	-0.074	***	0.000	***	-0.065	***	0.000	***
	lnDISTREGCENTER	-0.004	***	0.644		-0.002	***	0.000	***
	RAILWAY	-0.012	***	0.138		0.015	***	0.000	***
Tourism infrastructure	lnHIKING	0.004		0.789		-0.037	***	0.000	***
	lnTOURISM	0.001		0.038	**	0.039	***	0.000	***
Fiscal conditions	lnTAXBURDEN	-0.183	***	0.000	***	-0.413	***	0.000	***
Socio-demogr. characteristics	lnFOREIGNERS	-0.082	***	0.000	***	-0.187	***	0.000	***
Regional dummies	REGIONj	Yes				yes			
Adjusted R-squared:		0.8222				0.8402			
Number of observations:		40407				40407			

Notes: see Table 2.

[16] Corrected P-value from ANOVA
[17] Corrected P-value from ANOVA

Chapter 5

General Discussion

Landscape resources provide a variety of positive effects for human well being. They are important for local development and environmental benefits. For this reason researchers have studied the relationships between landscape resources and local development, local economics and local policy for more than 40 years. At first, economists like Rosen (1974) and Freeman (1974) approached the topic with classical economic theories and methods. Later, these first studies were improved and examined with different political (e.g., Cropper 1976) and geographical approaches (e.g., Haggett 1983). A turning point, important for our study, came with Smith (1990). He digressed from the classical resources-consumer relationship and took decision processes into account.

The first combined approaches of landscape analysis and economy, that developed in parallel and unrelated for many years, came with the field of disaster and risk-analysis. Thereby, GIS methods helped as integrative component to find answers to economic questions (e.g., Bocksteal 1996, Geoghegan 1997, Anselin 2006). These earlier studies constitute the theoretical basis for our research, although they focused only on single regions or communities and single landscape-related aspects.

The aim of this thesis was to investigate and to model the impact of landscape resources on local economy, local development and local policy decision with a comprehensive and complex approach. Therefore, this thesis integrates different factors based on detailed geographical, socio-economic and fiscal data. The focus is on the spatial modeling of the influence of landscape resources on the local level with a regional geographical perspective. Hence, the nation-wide availability of landscape data makes Switzerland an excellent case study.

To account for the different approaches of our research and to look more in detail at them, the following discussion focus on three different perspectives. First, I review the basic and general perspectives. Secondly, I turn to the political parameters. Thirdly, I focus on local development and local economy.

Basic and general perspectives

We have modeled the impact from landscape resources on local policy decision, local development and local economy using nation-wide data from Switzerland. Thereby, the question of the transferability to and the standardization of non-European types of landscape and heritage arises. But, to date there are no studies comparing the different impacts from different landscapes on local development.

Several US-studies (e.g., Freeman 1974, Smith 1990) and single European studies (e.g., Tyrväinen 1997) are the theoretical basis of our study. Furthermore, there are some studies from China and India (e.g., Konga et al. 2007, NAS 2001) with similar focuses on the relationship between landscape and local development, but with different results.

Consequently the question arises, are European landscape types (that are found in Switzerland) generally adaptable and transformable from Asian, American or African studies, and the associated data and approaches?

The main point of differences from studies on other continents is that European landscapes are on a smaller scale. Hence, we can conclude, our results are of interest to countries with similar basic conditions. For instance, Austria could be a good case study for transformation. But in contrast to Switzerland, the European Union has a larger impact on the economy and policy of Austria, and would need to be factored in. Other countries with similar conditions (geographical, economical and political) are Japan and New Zealand. Besides geophysical as well as socio-economic and political differences these other countries could show similar effects regarding the relationship between landscape amenities and local development.

In the last years several researchers have focused more and more on the landscape and townscape management variable of "open space" (e.g., Riddel 2001, Geoghegan 2002, Smith 2002, Irwin 2002, Marshall 2004, Cho et al. 2008). We have also considered open space in our analysis. Open space is generally examined as scarcity of landscape resources caused by urbanization processes. But the discussion about this scarcity distorts the general view for nature, because only urban areas are recognized. The inhabitants of rural areas does not care much about open space. In contrast, they care about other natural aspects in general, which need to be protected. Therefore, to take into account the requirements of rural areas we use additional amenity variables which expose the quality component and aspect of specific landscape elements.

It seems that the sensitivity and the care about accessibility and availability of landscape resources (especially landscape amenities such as open space and natural land) arises mostly in the urban population. The increasing mobility and nearly unlimited exchange of information decreases the differences between rural and urban population. Hence, urban environmental problems are also problems of the rural regions. Increasing mobility allows the population to use distant areas for recreation. Such mobility enhances urban areas while changing the environment of rural regions.

For a better modeling of the impact of these described landscape amenities, this thesis uses an approaches combining quality and quantity aspects with the complex connection of environment, economy, development and policy. Therefore, in our analysis we have used environment and location specific variables describing the landscape quality and quantity such as southern exposition and sunshine. But, we have determined that these variables only reflect aspects of urban areas. These results confirm earlier studies (e.g., Roback 1982, Blomquist et al. 1988) and display a scarcity of information about rural regions. We can account for this lack of knowledge because, as we point out, current quality and quantity variables are less important in rural areas than expected.

Beside quality and quantity aspects of landscape, effects of time variants of natural resources (discussed in Chapter 4 and by former researchers, e.g., Freeman 1993, Riddel 2001) are important for all three approaches in this thesis, because landscape processes are often dynamic and time trends depend on the duration of the research period. This thesis focuses on an approximate ten-year period. We assume for our approaches a low dynamic and no time variants.

However, in the environmental economic literature there is a lack of publications that consider long-term measurements with complex landscape changes and impacts on local development. Thus, research fields of landscape ecology, environmental history and local development need to be connected with environmental economics in further studies.

Political parameters

Negative externalities have an impact on the costs of policy decisions. These costs are transferred in taxes that are reflected by market prices. This is especially important for non-market landscape resources. Therefore, Smith (1996) points out that scale (area, time) and valuation (benefits) has to be considered in willingness-to-pay observations for these indirect costs. He discusses the efficiency of decision making processes and pursues questions about how decision making processes can be improved and how the population can be better informed, because this can have an impact on the social consensus.

The following example of water power's requirement of reservoirs clearly explains these concerns: A clearly advantage of reservoir development is the positive influence on employment, because reservoirs need support and service personnel. In contrast, a disadvantages is the intervention and manipulation of the ecosystem. That can have an impact on recreational facilities and the property market, because new reservoir projects can lead to a loss on local attractiveness. This example demonstrates the tightrope walk between different views and demand for locational development.

The results given in Chapter 2 show that specific policy approaches influence the support for landscape management. For instance, in the high-income region of Zurich we can point out stronger financing support in contrast to regulation support as well as urban-rural differentiation. These differences play an important role with regards to different policy approaches. The urban population benefits from environmental protection arrangements because it often profits from the environmental attractiveness of rural communities. For instance, the urban population supports environmental policy decisions in rural regions endowed with recreational facilities. In contrast, the rural population argues according to the standpoint of employment and living quality. In considering these contrary points and in agreement with former studies we assume that western societies with high socio-economic standards and levels have a similar differentiation. But today it is not possible to compare environment-related proposition results between different cantons in Switzerland because there are only two special election data available for the canton of Zurich.

In view of the results from Chapter 3 and 4 we can point out that the finance component has a compensation character (e.g., regarding property prices). Therefore, we assume similar socio-economic structures in all cantons and we expect similar political decisions in rural and low income regions of Switzerland. We found that policy approaches are strongly linked with the type of financing system. Therefore, we consider that different approaches can lead to different successes for environmental policy decisions depending on the income level (Kotchen and Powers 2006). Hence, the normal good “environment” is susceptible to manipulations, which stands in contrast to common research assumptions (e.g., Kahn and Matsusaka 1997).

In all of the political parameters discussed here we can clearly emphasize that political decisions and therewith connected financing support in Switzerland in the context of landscape management are in line with U.S. studies which are linked with the preservation of open space and landscape amenities (Kline and Wichelns 1994). Therefore, we assume that the population in communities that benefit from public subsidies (e.g., for historical heritage) also supports public financing for landscape management. Hence, landscape quality aspects become increasingly important.

Perspective on local development and local economy

The nationwide investigation of the complex connection of income, population, employment, property, landscape amenities and landscape quality aspects to local development and to local economy is the main difference between this thesis and earlier research. The convergence of smaller and larger communities in Switzerland indicates a heterogeneous landscape endowment. Therewith connected are differences of political decisions, local development and local economy. We place a special emphasis on both of these issues in this thesis.

The clear estimates for the impact of landscape amenities (such as open space) and population change on employment are confirmed with the causal coherence of economic development on the local level. But, the evidence on effects of small scaled high-quality landscape elements (e.g., near-natural land) is limited (see Chapters 3, 4). In contrast, the link between heritage townscape and inventory of nationally significant landscape with consideration to employment clearly shows that political power has a strong impact on regions and local development.

With regards to the special conditions of the connection between policy, employment and economy in Switzerland, we have to be careful with conclusions of the transferability to other countries. For instance, the impact from policy on employment is very low in Switzerland in comparison to other European countries. Therefore, it is necessary to consider the range of fields for an objective and comprehensive analysis and estimation.

If we look more in detail at the Swiss policy, development and economy conditions we can show that agricultural policy is the binding element among Chapters 2, 3 and 4. As discussed in Chapter 3, for example, communities with a high grade on national subsidies do not themselves benefit from their local amenities. Local authorities do not have an incentive to implement national policies. The power from the local region itself is lower than the national interest. Hence, in these regions it is difficult to analyze the real impact of landscape amenities on local development. Regarding landscape protection and landscape management, the interest groups differ with view to the agricultural subsidy policy. There is a lack of studies investigating these perspectives in an objective way. The regional economy strongly benefits from income subsidies. For instance, these subsidies influence the access to the property market and hence they camouflage the local economic development. In contrast, the impact of natural resources on regional development can be marginal in contrast to the power of subsidies. But, these disguise problems can be limited with the inclusion of the factor of time, because in this way over a long time period landscape changes are measurable and observable. Therefore, amenity-driven development and life-cycle effects can be an approach to understanding the link between amenities, economic development and environmental policy. Furthermore, Investigations regarding the kind of amenities and consequences of socio-economic characteristics could be an important focus for the future (Clark and Hunter 1992).

References

Anselin, L., 2006. GeoDa: An introduction to spatial data analysis. Geographical Analysis 38(1):5-22.

Blomquist, G.L., Berger, M.C., Hoehn, J.P., 1988. New estimates of quality of life in urban areas. The American Economic Review 78(1):89-107.

Bocksteal, N.E., 1996. Modeling economics and ecology: The importance of a spatial perspective. American Journal of Agricultural Economics 78(5):1168-1180.

Cho, S.-H., Poudyal, N.C., Roberts, R.K., 2008. Spatial analysis of the amenity value of green open space. Ecological Economics 66(2-3):403-416.

Clark, D.E., Hunter, W.J., 1992. The impact of economic opportunity, amenities and fiscal factors on age-specific migration rates. Journal of Regional Science 32(3):349-365.

Cropper, M., 1976. Regulating activities with catastrophic environmental effects. Journal of Environmental Economics and Management 3(6):1-15.

Freeman III, A.M., 1974. On estimating air pollution control benefits from land value studies. Journal of Environmental Economics and Management 1(1):74-83.

Freeman III, A.M., 1993. The measurement of environmental and resource values. RFF Press, Washington, USA.

Geoghegan, J., Wainger, L.A., Bocksteal, N.E., 1997. Spatial landscape indices in a hedonic framework: An ecological economics analysis using GIS. Ecological Economics 23:251-264.

Geoghegan, J. 2002. The value of open spaces in residential land use. Land Use Policy 19(1):91-98.

Haggett, P., 1983. Geographie – Eine moderne Synthese. Harper & Row, New York, USA.

Irwin, E.G., 2002. The effects of open space on residential property values. Land Economics 78(4):465-480.

Kahn, M. E. and J. G. Matsusaka. 1997. Demand for environmental goods: Evidence from voting patterns on California initiatives. Journal of Law and Economics 40(1):137–173.

Kline, J. and D. Wichelns. 1994. Using referendum data to characterize public support for purchasing development rights to farmland. Land Economics 70(2):223–233.

Fanhua Konga, F., Yinb, H., Nakagoshia, N., 2007. Using GIS and landscape metrics in the hedonic price modeling of the amenity value of urban green space: A case study in Jinan City, China. Landscape and Urban Planning 79(3-4):240-252.

Kotchen, M. J. and S. M. Powers. 2006. Explaining the appearance and success of voter referenda for open-space conservation. Journal of Environmental Economics and Management 52(1):373–390.

Marshall, E., 2004. Open space amenities, interacting agents, and equilibrium landscape structure. Land Economics 80(2):272-293.

More, T.A., Stevens, T., Allen, P.G., 1988. Valuation of urban parks. Landscape and Urban Planning 15(1-2):139-152.

NAS 2001. Growing populations, changing landscapes: Studies from India, China, and the United States. Indian National Science Academy, Chinese Academy of Sciences and U.S. National Academy of Sciences. National Academies Press, Washington, USA.

Riddel, M., 2001. A dynamic approach to estimating hedonic prices for environmental goods: An application to open space purchase. Land Economics 77(4):494-512.

Roback, J., 1982. Wages, rents, and the quality of life. Journal of Political Economy 90(6):1257-1277.

Rosen, S., 1974. Hedonic price and implicit markets: Product differentiation in perfect competition. Journal of Political Economy 82(2):34-55.

Smith, V.K., 1990. Estimating recreation demand using the properties of the implied consumer surplus. Land Economics 66(5):111-20.

Smith, V.K., 1996. Estimating economic values for nature: Methods for non-market valuation. Edward Elgar, Cheltenham, United Kingdom.

Smith, V.K., Poulos, C., Kim, H., 2002. Treating open space as an urban amenity. Resource and Energy Economics 24(1-3):107-129.

Tyrväinen, L., 1997. The amenity value of the urban forest: an application of the hedonic pricing method. Landscape and Urban Planning 37(3):211-222.

Chapter 6

Summary / Zusammenfassung

Summary

Landscape resources provide a variety of positive externalities, as shown in many studies before. Better knowledge of these positive effects is important for future development and for environmental benefits. However, the relationship between local development and the imposing amenities of both natural landscapes and historical heritage in Switzerland has not been studied so far.

This thesis therefore looks into the question of how publicly provided landscape resources and historical heritage affect local policy decision, local development and local economics based on detailed geographical, socio-economic and fiscal data. The nation-wide availability of landscape data makes Switzerland an excellent case study.

To find an answer to our main research question, the work presented here is based on three approaches: First, we provide political issues, support and demand for environmental protection. Secondly, we apply a regional growth model to quantify and model effects of natural amenities on population and employment change. Thirdly, we investigate how residential rent prices are affected by landscape and townscape management as well as natural amenities using the hedonic pricing method.

The combination of these approaches allows us to comprehensively cover the complex system of landscape and local policy, local development and local economy. For example, population growth as well as property prices can be affected by natural amenities. The approaches focus on European types of landscape and historical heritage development.

After a general introduction to the background of this thesis (Chapter 1), we delve into the first approach (local policy issues) in Chapter 2 as we analyze the voter support for a regulation proposition to create landscape reserves in the densely populated canton of Zurich, in an effort to understand the demand for alternative approaches to landscape management for designing efficient policies and acceptable financing arrangements. We then contrast the pattern of voter support for this “regulation” measure with the support for a “financing” measure within the same population. This financing measure was proposed

to maintain landscape quality through increased public spending for the management of landscape amenities and historical heritage. With our results we can point out that the demand for both landscape regulation and financing increased with decreasing local open space. The role of income differed between the two propositions and between more urban or rural populations. Hence, landscape management may greatly matter for the distribution of the perceived benefits and costs across different income classes. For instance, in the present Swiss context, the framing of the protection issue as a “financing proposition” appeared to be more compelling to people with high incomes than the regulation framing. Our descriptive results contribute to the design of widely acceptable policies and financing arrangements.

In Chapter 3, we examine how landscape amenities and related policies affected regional development. Therefore, we apply the classic simultaneous equations model by Carlino and Mills (1987) to data from 2467 municipalities in Switzerland along with fiscal, demographic and infrastructure variables in the period from 1995 to 2005. Our analysis shows that the results for traditional locational factors are in line with earlier research. We find that population was positively affected by closeness to major lakes and by abundance of open space. However, the impact of visual landscape amenities measured by the proportion of high-quality landscape features is ambiguous (e.g., shore vegetation). We find that employment growth was fostered by population growth, proportion of foreigners and accessibility of a municipality. Moreover, communities with a highly service-oriented sectoral structure and a small non-active population tended to grow faster. In contrast, municipalities with legally protected amenities, such as national heritage townscapes and landscapes of national significance, tended to grow less than others. This result may be in line with the political intentions of the national legislature, but it also suggests that these municipalities themselves did not benefit from their local amenities. Our results in Chapter 3 help to understand the factors that impact regional development and to provide a better forecast for future development on the local level.

Finally, we are concerned with the third approach of this thesis (local economy) in Chapter 4, as we address the question of how local landscape resources affect property prices using the hedonic pricing method. With the nation-wide availability of landscape data for this purpose we analyze a cross section of 80814 apartments in 956 Swiss communities. Along with other property attributes (e.g., rental prize, living surface), our analysis includes GIS-based municipality-level variables which characterize location-specific amenities and other neighborhood features (e.g., altitude of a community, distance to the next city center). Using a broad set of explanatory variables, we show that several aspects of landscape and townscape management as well as natural amenities have a strong impact on property prices. Thereby, a southern exposition, lake view, open space, historical heritage and land for recreational activities played the most important role in determining the attractiveness of a location. We can confirm the well-known differences between rural and urban locations in regard to landscape resources. Our results support the idea that settlement pressure which is also reflected in property prices tends to increase the population’s sensitivity towards landscape changes. Overall, our investigations are of interest to policy makers, since they help to promote environmental benefits of non-market landscape resources on the property market in Switzerland.

This thesis makes a contribution to the field of environmental economics, environmental policy and regional geography. Our results are an empirical basis for arguments for public finance of environmental goods and regional policy decisions. We present the first nation-wide approach in the research field of landscape resources and local economic development. Furthermore, we create a large nation-wide GIS-based dataset, which is unique for Switzerland. We can show that landscape resources affect local development and that landscape management has an important impact on local economy and policy-making processes.

Zusammenfassung

Landschaftsressourcen bieten eine Reihe positiver externer Effekte, wie bereits in vielen Studien zuvor aufgezeigt wurde. Bessere Kenntnisse dieser positiven Effekte sind für die zukünftige Entwicklung und den Umweltnutzen wichtig. Jedoch wurde die Beziehung zwischen lokaler Entwicklung und den eindrucksvollen Annehmlichkeiten sowohl der Naturlandschaft als auch des historischen Kulturerbes in der Schweiz bisher noch nicht erforscht.

Daher wird in dieser Arbeit auf der Basis von detaillierten geographischen, sozioökonomischen und finanzwirtschaftlichen Daten die Frage untersucht, wie öffentlich zugängige Landschaftsressourcen und historische Kulturgüter lokal-politische Entscheidungen, lokale Entwicklung sowie lokale Wirtschaft beeinflussen. Die flächendeckende Verfügbarkeit von Landschaftsdaten macht die Schweiz zur exzellenten Fallstudienregion.

Um eine Antwort auf unsere Forschungsfrage zu finden, basiert diese Arbeit auf drei Ansätzen: Zuerst erörtern wir politische Fragen, bezüglich Unterstützung und Anforderung für den Umweltschutz. Als Zweites verwenden wir ein regionales Wachstumsmodel, um die Effekte von attraktiven Landschaftsobjekten auf den Bevölkerungs- und Arbeitsplatzwandel zu quantifizieren und zu modellieren. Schliesslich untersuchen wir mit der hedonischen Preismethode, inwiefern Mietpreise durch Landschafts- und Stadtmanagement sowie durch attraktive Landschaftsobjekte beeinflusst werden.

Die Kombination dieser unterschiedlichen Ansätze ermöglicht eine umfassende Betrachtung des komplexen Systems aus Landschaft und lokaler Politik, lokaler Entwicklung sowie lokaler Wirtschaft. Zum Beispiel werden sowohl das Bevölkerungswachstum als auch die Immobilienpreise durch attraktive Landschaftsobjekte beeinflusst. Der Fokus der Untersuchung bei allen drei Ansätzen liegt auf europäischen Landschaftstypen und der historischen Kulturentwicklung Europas.

Nach einer allgemeinen Einführung zum Hintergrund dieser Arbeit (Kapitel 1), konzentrieren wir uns in Kapitel 2 auf lokal-politische Belange, indem wir das Wählerverhalten bei einer Regulationsabstimmung zur Errichtung von Landschaftsreservaten untersuchen. Hierzu analysieren wir, am Beispiel des Kantons Zürich, inwieweit alternative Ansätze im Landschaftsmanagement durch die urbane Bevölkerung dicht besiedelter Räume unterstützt werden und leiten Anforderungen und Massnahmen zur Optimierung von politischen und finanziellen Abläufen ab. Anhand der gleichen Bevölkerungsgruppe vergleichen wir zudem das Wählerverhalten für eine Finanzierungsabstimmung. Diese Finanzierungsabstimmung befasst sich mit dem Erhalt der Landschaftsqualität und schlägt die Erhöhung der öffentlichen Gelder für das Management von attraktiven Landschaftsobjekten und historischen Kulturgütern vor. Mit unseren Ergebnissen können wir aufzeigen, dass der Bedarf sowohl für Landschaftsregulation als auch für Landschaftsfinanzierung mit sinkendem lokalem Freiflächenanteil ansteigt. Während das Einkommen auf die Regulationsabstimmung keinen Einfluss hat, ist dieser Faktor für die Finanzierungsabstimmung jedoch relevant. Des Weiteren unterscheidet sich der Einfluss des Einkommens auf das Abstimmungsverhalten zwischen urbaner bzw. ländlicher Bevölkerung. Demzufolge könnte das Landschaftsmanagement für die Verteilung der Benefiz- und der Kostenwahrnehmung besonders im Hinblick auf unterschiedliche Einkommensklassen von Bedeutung sein. Dies zeigt sich beispielsweise im gegenwärtigen schweizerischen Kontext in der Frage des Umweltschutzes, bei der der Finanzierungsansatz gegenüber dem Regulierungsansatz stärker auf Menschen mit hohem Einkommen ausgerichtet ist. Unsere Ergebnisse sollen dazu beitragen, weit akzeptierte politische und finanzielle Arrangements zu entwickeln.

In Kapitel 3 untersuchen wir, wie attraktive Landschaftsobjekte und diesbezügliche Umweltpolitik die regionale Entwicklung beeinflussen. Dazu wenden wir das klassische simultane Gleichungsmodel von Carlino und Mills (1987) mit Daten von 2398 Gemeinden in der Schweiz an. Unsere Analyse anhand finanz-wirtschaftlicher, demographischer und infrastruktureller Variablen für die Periode von 1995 bis 2005 zeigt, dass die Ergebnisse für traditionelle Standortfaktoren mit früheren Forschungsarbeiten übereinstimmen. Wir können aufzeigen, dass die Bevölkerungsentwicklung durch die Nähe der Gemeinden zu grossen Seen und durch das Vorhandensein zahlreicher Freiflächen positiv beeinflusst wird. Jedoch ist der Einfluss von visuell attraktiven Landschaftsobjekten gemessen am Anteil qualitative hochwertiger Landschaftselemente nicht eindeutig (z.B. Ufervegetation). Wir können aufzeigen, dass das Beschäftigungswachstum durch das Bevölkerungswachstum, dem Ausländeranteil und der Erreichbarkeit begünstigt wird. Des Weiteren tendieren Gemeinden mit einer stark serviceorientierten Sektorstruktur und geringem Anteil an Nichterwerbspersonen dazu, schneller zu wachsen. Aber Gemeinden mit geschützten Landschaftsobjekten, wie zum Beispiel schützenswerte historische Stadtkulturgüter und Landschaften von nationaler Bedeutung, weisen ein langsameres Wachstum als andere auf. Dieses Ergebnis könnte im Zusammenhang mit politischen Intentionen der nationalen Gesetzgebung stehen. Aber es deutet auch darauf hin, dass diese Gemeinden nicht allein von lokalen, attraktiven Landschaftsobjekten profitieren. Unsere Ergebnisse in Kapitel 3 helfen, die Einflussfaktoren auf die regionale Entwicklung zu verstehen und eine bessere Prognose für die künftige Entwicklung auf lokaler Ebene anzubieten.

Schließlich beschäftigen wir uns mit lokale Wirtschaftfaktoren in Kapitel 4, indem wir der Frage nachgehen, wie lokale Landschaftsressourcen Immobilienpreise beeinflussen. Zur Analyse verwenden wir die hedonische Preismethode. Mittels flächendeckender Verfügbarkeit von Landschaftsdaten können wir einen Querschnitt von 80814 Mietwohnungen in 956 Schweizer Gemeinden analysieren. Neben Immobilieneigenschaften (z.B. Mietpreis, Wohnfläche) haben wir GIS-basierte Gemeindevariablen in unsere Analysen integriert, die die Standortspezifik und andere Nachbarschaftseigenschaften (z.B. Höhenlage der Gemeinde, Distanz zum nächsten

Stadtzentrum) beinhalten. Durch die Nutzung eines grossen Pools von Erklärungsvariablen können wir aufzeigen, dass verschiedene Aspekte des Landschaft- und Stadtmanagements sowie attraktive Landschaftsobjekte einen starken Einfluss auf Immobilienpreise haben. Dabei spielen Südlage, Seesicht, Freiflächen, historische Kulturerbe und Erholungsgebiete die entscheidende Rolle für einen attraktiven Standort. Wir können die bekannte Unterschiede zwischen ländlichen und städtischen Standorten in Bezug auf Landschaftsressourcen bestätigen. Unsere Ergebnisse bekräftigen die Aussage, dass Siedlungsdruck, reflektiert in Immobilienpreisen, tendenziell zum Anstieg der Sensibilität der Bevölkerung gegenüber Landschaftsveränderungen führt. Insgesamt sind unsere Untersuchungen für politische Entscheidungsträger interessant, da sie die Wichtigkeit des Umweltbenefiz von nicht handelbaren Landschaftsressourcen auf den Immobilienmarkt in der Schweiz belegen.

Diese Dissertation leistet einen wichtigen Beitrag im Bereich Umweltökonomie, Umweltpolitik und Regionalgeographie. Unsere Ergebnisse sind eine empirischen Grundlage für die Argumentation der öffentlichen Finanzierung von Umweltgütern und für regionalpolitische Entscheidungen. Wir präsentieren den ersten flächendeckenden Ansatz im Forschungsbereich Landschaftsressourcen und lokaler Wirtschaftsentwicklung. Des Weiteren haben wir einen grossen flächendeckenden GIS-Datensatz erstellt, der einmalig für die Schweiz ist. Wir können aufzeigen, dass Landschaftsressourcen die lokale Entwicklung beeinflussen und dass Landschaftsmanagement einen entscheidenden Einfluss auf die lokale Wirtschaft und politische Entscheidungsprozesse hat.

Acknowledgements

"Auch wenn ich wüsste, dass die Welt morgen untergeht, würde ich dennoch heute ein Apfelbäumchen pflanzen." (Volksmund)

Eine Vielzahl von Personen haben Anteil an dieser Arbeit. Diesen Personen ist das Apfelbäumchen symbolisch gewidmet. Herzlichen Dank an:

Julian Baker, Mark Berge, Axel Dreher, Hans Elsasser, Meine Familie, Rachel Gimber, Marlén Gubsch, Marc Hall, IFUs, Xenia Junge, Petra Lindemann-Matthies, Jana Petermann, Philipona & Brügger, Monika Rau, Marco Salvi, Ronald Schmidt, Isabel Schöchli, Stefan Schwegler, SNF, Lilli Strasser, Eva Vojtech, Steffi von Felten, Luca Wacker, Randall Walsh, Fabian Waltert, WIGs

Besonderer Dank geht an Bernhard Schmid für den Vorsitz des Promotionskomitees und die Leitung der Dissertation. Felix Schläpfer danke ich für die Leitung des Nationalfondprojektes „How publicly provided landscape resources and historical heritage affect local economic change“, sowie dem SNF für die Finanzierung der Dissertation.

Ganz besonders danke ich dir, Viktoria, du hast mir gerade in der Abschlussphase den Rücken gestärkt, mich motiviert und aufgebaut bei allfälligen Krisen während der Arbeit.

Curriculum Vitae

Curriculum vitae

Name	Schulz
Vorname	Thomas
Geburtsdatum	30.12.1977 in Cottbus
Nationalität	Deutsch
Ausbildung	
1992 – 1997	Fürst-Pückler-Gymnasium in Cottbus, Abschluss: Mai 1997, Abitur
1998 – 2005	Studium der Geographie an der Technischen Universität Dresden, Diplomarbeit: "Die Analyse der Vektordaten für die Flächennutzung hinsichtlich ihrer Eignung in Umweltinformationssystemen - Vergleich der Datensysteme der Schweiz und Deutschlands", Abschluss: Januar 2005, Diplomgeograph
2005 – 2009	Doktorand an der Universität Zürich, Institut für Umweltwissenschaften, Thema: “Modeling the impact of landscape resources on local policy decision, local development and local economy“
Gegenwärtige Stellung	Projektleiter GIS-Entwicklung, Ingenieurbüro Philipona & Brügger, Plaffeien (FR)

Publikation

- Schulz, T., Schläpfer, F., 2009. Demand for Landscape Management: Regulation versus Financing. Society and Natural Resources, 22:1, 27-41, 2009.